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White House Conference on Environmental Technology

Working Papers
From the Conference Held
In Washington, D.C.
December 11–13, 1994

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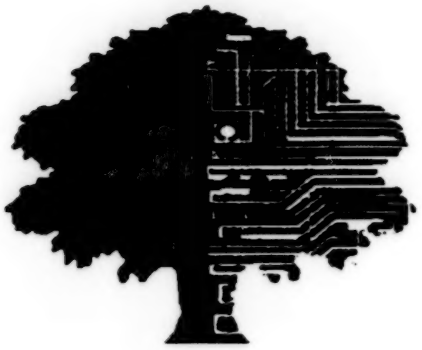

WHITE HOUSE CONFERENCE ON ENVIRONMENTAL TECHNOLOGY

WORKING PAPERS ON THE CONFERENCE HELD IN WASHINGTON, D.C. AT THE GRAND HYATT HOTEL DECEMBER 11-13, 1994

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Note: This is a collection of working papers on the conference deliberations. The suggestions in these working papers have not been endorsed by the National Science and Technology Council or by any federal agency. The transcripts of conference speeches and of the plenary roundtable are edited and abridged.

PREFACE

Vice President Al Gore and a group of senior Clinton Administration officials met with more than 1,400 industry, environmental, and government leaders from around the United States on December 11-13, 1994, at the Grand Hyatt Hotel in Washington, D.C., to discuss ways to promote economic growth and job creation while preserving the environment.

The goal of the White House Conference on Environmental Technology was to lay the groundwork for developing a national strategy for deploying a new generation of advanced environmental technologies -- technologies with potential to improve U.S. economic competitiveness and position U.S. industry for world leadership in international markets, while at the same time providing for more effective and sustainable environmental protection.

Senior Administration officials joining Vice President Gore and myself as speakers at the conference included Secretary of Commerce Ron Brown, Secretary of Energy Hazel O'Leary, U.S. Environmental Protection Agency Administrator Carol Browner, National Aeronautics and Space Administration Administrator Dan Goldin, and U.S. Agency for International Development Administrator Brian Atwood. They were joined by U.S. Senator Joseph Leiberman (Connecticut); business leaders representing both small and large companies, including Ralph Peterson, CEO of the CH2M Hill Corporation; environmental leaders, including Jonathan Lash, President of the World Resources Institute and Co-Chair of the President's Council for Sustainable Development; academic experts and leaders, including George Washington University President Stephen Trachtenberg; and state and local government officials from around the country including Vermont Governor and National Governors' Association Chairman Howard Dean.

The top priority for the Clinton Administration in crafting a National Environmental Technology Strategy is to strengthen the ability of U.S. private industry to develop, commercialize, and put into use new environmental technologies. Participants in the conference met to discuss development and commercialization of new environmental technologies, lowering regulatory barriers to the use of new technologies, developing and financing the U.S. environmental technology market, promoting environmental technology exports, and fostering the transition to long-term economic growth that creates jobs while improving and sustaining the environment.

The White House Conference on Environmental Technology was the culmination of more than twenty workshops held around the country by the Administration in the previous six months to obtain inputs from various regions, industries, and other stakeholders concerning the developing National Environmental Technology Strategy. The conference was sponsored by the National Science and Technology Council (NSTC). The NSTC, a cabinet-level White House policy council established and chaired by the President, is responsible for coordinating science and technology programs and policies throughout the federal government.

The strategy development effort, the conference, and the workshops are all part of the Administration's Technology for a Sustainable Future (TSF) initiative which is managed by an interagency environmental technology working group under the auspices of the NSTC and the White House Office of Science and Technology Policy (OSTP). The TSF initiative was launched by Vice President Gore on July 15, 1994, with the release of the report *Technology for a Sustainable Future: A Framework for Action*.

Since the White House Conference, as additional local and regional workshops are being held, OSTP and the environmental technology working group have been working with industry, state governments, and other stakeholders to craft a truly national strategy to advance the use of American-produced environmental technology. Although the National Environmental Technology Strategy will be released by the federal government, it will attempt to reflect the views of industry, academia, non-governmental organizations, and government as to how we as a nation can advance the development, commercialization and use of environmental technologies. he Administration will release the National Environmental Technology Strategy during Earth Week in April 1995.

To facilitate the preparation of the National Environmental Technology Strategy, the accompanying collection of working papers on the December 1994 White House Conference on Environmental Technology has been compiled. The suggestions reported in these working papers have not been endorsed by the NSTC or by any federal agency. The transcripts of conference speeches and of the plenary roundtable are edited and abridged.

John H. Gibbons
Assistant to the President for
Science and Technology Policy

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SECTION A

PLENARY SESSION

ADDRESSES

Remarks by John Gibbons
Conference Chairman and
Assistant to the President for Science and Technology Policy

Welcoming Remarks

On behalf of the Administration and the National Science and Technology Council (NSTC), I am delighted to welcome you to this White House conference. The President created the NSTC a year ago to help facilitate this kind of merging of the interests of federal agencies with the private sector to enable things to happen that simply could not happen before. The NSTC complements the National Security Council, the National Economic Council, and the Domestic Policy Council by creating within the White House an ability to assemble across the federal agencies a collective kind of wisdom about science and technology, and the associated capability for action and planning and integration of federal programs. As with regard to the other councils, the President chairs the NSTC, with the Vice President chairing in the President's absence. The members of the NSTC include the heads of federal agencies that contain significant technology, i.e., most all of the major agencies.

The Administration firmly believes that improved environmental technologies can play a key role in achieving a more productive, efficient, and sustainable society and economy. An early, central tenet of the Administration was that we should be shifting our attitudes. We believe that the old-time notion that economic growth and environmental quality are antagonistic is just plain wrong. The evidence is growing rapidly that economic growth and environmental quality can be consonant, mutually supportive, and reinforcing if we use our technological ingenuity.

Another old paradigm that we see as anachronistic is that the people and government by nature operate in opposition to one another, rather than working together to achieve common goals. That we can work productively together will be demonstrated during this conference and by actions which government and the private sector will be taking together in the coming months. We will be linking public and private ends, combining strengths so that in effect one plus one equals about four instead of two.

U.S. science and engineering and technology systems work best when they are challenged. We Americans like challenges, puzzles to solve, and new games to play. The notion of sustainable development presents an exciting challenge, both domestically and globally. We know increasingly how much our actions here in the United States affect the rest of the world, and vice versa. We are no longer a nation in isolation. Instead, we are very much a part of the whole of the planet.

We firmly believe that U.S. industry has the innovative capacity and the entrepreneurial spirit necessary to respond to this challenge and to create a new generation of environmentally sound products and processes. We also believe that there is an important key role for the public sector, particularly to help define and sustain the demand for environmental quality. Government does this through affirmative and enabling public policies, including through initiatives to increase public understanding of and support for what can and needs to be done.

A big role for government is to be a true partner with regard to research. Government can be especially helpful in supporting research that leads to generic and pre-competitive capabilities, i.e., capabilities that the private sector would not be able to attain alone. For example, government can support research areas that do not meet the hurdle criteria or requirements for private industry

investment. Clearly collaboration and partnerships are going to be the keys to developing new environmental technology solutions and to bringing them to the marketplace. Japanese businessmen employ the word **keyosi** which they use somewhat like we use "symbiosis." **Keyosi** means living and working together for a common good. It seems to me that the spirit of **keyosi** lies behind the kinds of things we are going to discuss at this conference.

Together we must transform our technological infrastructure to use less energy and less materials, to cause less environmental harm, and, at the same time, to provide those goods and services that we all desire. In this joint endeavor, we seek more than small steps down the familiar technological paths. Instead, we seek a transformation of our industrial economy, a transformation involving technological ingenuity and a people committed to stewardship. We seek a transformation of our industrial economy into an economy that leads the world in demonstrating that economic vitality, environmental quality, and resource sustainability are simultaneously achievable.

To achieve this goal, we have to forge a common vision, creative strategies, and a shared commitment. This conference is a step in that direction, a step towards developing a National Environmental Technology Strategy. The emerging strategy will reflect the broad wisdom and diverse perspectives of the participants in this conference. In the course of the next two days, we want you to join with your colleagues from industry, academia, non-governmental organizations, and federal, state and local government to help formulate the key elements of this strategy; and the nature of the partnerships, policies and actions which will be crucial to the strategy's realization. In the end, our strategy must be your strategy. All of us are the catalysts for developing the strategy.

Luncheon Remarks on December 12

This afternoon we are going to be turning to the 14 breakout sessions where the real work begins. We expect and anticipate an intense degree of participation on the part of all of you in these breakout sessions. And we look forward to receiving your best ideas however revolutionary or argumentative. Thomas Jefferson said that "freedom rings where opinions clash." So let us hear some freedom ringing this afternoon as we try to identify and resolve our issues.

I want to mention that subscriptions to the Global Network for Environmental Technology (GNET) are going to be free of charge to all the users throughout the period between now and Earth Day. This is to help facilitate the further engagement of this wonderful bunch of people in the months between now and next April. A sign-up sheet is included with your conference materials. Please exercise that opportunity. You can also visit the GNET demonstration area just outside of this room.

Luncheon Remarks on December 13

I am very pleased to see the extensive networking underway at this conference. The things that we are working on together are taking form, they are jelling. To me, the energy level here is still remarkably high. I applaud all of you for collectively bringing such energy and wisdom to a process that all of us have so much of a stake in. I would like to say again how much a pleasure it has been to be part of the National Science and Technology Council's work in helping catalyze the presence and contributions of so many of the federal agencies. The fact that we have heard at this conference from so many heads of federal departments and agencies is a testimony to a new kind of virtual process that we are pursuing under President Clinton and Vice President Gore to make the whole greater than the sum of the parts. I also want to express my special appreciation to some others:

- To Ralph Peterson, the CEO of CH2M Hill, for his leadership and support of the Technology for a Sustainable Future (TSF) initiative since the beginning, and for addressing us yesterday.

- To Howard Dean, the Governor of Vermont and Chair of the National Governors' Association, for sharing his perspectives with us yesterday in the plenary session.

- To Jonathan Lash, the President of the World Resources Institute and Co-Chair of the President's Council for Sustainable Development, for his commitment and participation yesterday and today and for his long-term support of the notion of sustainable development as a global initiative.

- To Steve Trachtenberg, the President of George Washington University who, as we heard yesterday, is collaborating with Administrator Carol Browner and the EPA to begin a unique greening of that urban university. I commend him for his vision and his commitment to innovation.

- To Victor Ashe, the Mayor of Knoxville, Tennessee, and Chair of the U.S. Conference of Mayors, and to Fred Krupp of the Environmental Defense Fund, both of whom were ready to join us as speakers but who were precluded by illness from doing so.

- To the Energy Department's Tom Grumbly and Clyde Frank, and their team which includes the Waste Policy Institute, for the leadership and support that they have consistently given to the TSF initiative.

- To Tom Harvey and Bill Robertson of the Global Environment and Technology Foundation, and to Cindy Cobb of Global Initiatives, Inc., for all of their organizing work and the incredible kind of back room activity that has made everything run so smoothly.

I also salute my colleagues Mark Schaefer, Tim Newell, Dave Rejeski, Tom Houlihan and the entire Office of Science and Technology Policy team which has worked so diligently over so many months on this initiative and the conference. They have worked hard to take environmental technology to a national level of dialogue and attention. I think the effort is making a difference. Environmental technology is going to be a subject of considerable debate and concern in the spring and we are going to need help and participation from all of you in that process.

Finally, I want to thank each of you for coming and sharing so freely of your ideas, of your doubts as well as your convictions. We encourage you to continue that sharing process. It will certainly significantly help us as we develop the National Environmental Technology Strategy.

Keynote Address by Vice President Al Gore

Introductory Remarks by John Gibbons: It is a great pleasure for me to introduce the Vice President of the United States. As you know, he not only deeply believes in the cause that we are gathered here to talk about but he also has profound knowledge about the subject. His commitment to environmental quality is probably the highest and most profound among world leaders. I know that you are as enthusiastic as I am and as grateful as I am for his steadfast commitment and his leadership in this most worthy enterprise.

Vice President Al Gore: I really appreciate the warmth of this welcome. And, Jack Gibbons, thank you very much for your kind words and for your hard work, imagination, and leadership in organizing this conference. To all of you, ladies and gentlemen, thank you for attending, and thank you for the work, interest and commitment that has preceded your arrival here. I am so pleased to see this room filled to overflowing, and I am encouraged and optimistic by the action-packed agenda that you have before you. I look forward to participating at various points during the conference. This conference is part of a process that has been on-going for some time and I am very excited by it and grateful that you all are here.

Twenty-five years ago, when Commander Neil Armstrong was invited to address a joint session of Congress after his moon voyage, he said, "man must understand his universe in order to understand his destiny." The Apollo missions and all of our journeys into space have done so much to help us understand our universe. But they have also given us a chance to gaze on our own world which was also, to some extent, unexplored. None of us will ever forget those grainy images of our astronauts pressing their boots down and planting an American flag on the surface of the moon. But Apollo not only changed our view from this planet. It also changed our view of our own planet and made us realize the fragility of our own world. I think even before Armstrong's famous step, the image of the earth that Frank Borman's mission broadcast back, with the earth rising over the moon's horizon, was a breakthrough for millions, perhaps billions, of people, who had conceived of the earth as an entire entity. Thus, we were greatly assisted, at least I was, by the ability to see the earth visually, as it really is, surrounded by an infinite black backdrop.

I do not believe it was a coincidence that the first Earth Day in 1970 immediately followed our first missions to the moon. This new awareness, the new ability to see the earth floating in space, led directly to a new ability on the part of so many of us to understand the importance of protecting the earth against the insults of pollution and carelessness that are now posing new threats to the ecological system of the entire earth. Thus, it also is not a coincidence that the National Environmental Policy Act became law in 1970. Twenty-five years ago we faced a huge environmental challenge. We still do. But it is important to acknowledge the progress that we have made. Twenty-five years ago many people simply could not swim or fish in waters near major urban centers. Unfortunately, that is still true for some of them. The disposal of municipal waste, uncontrolled use of pesticides and herbicides, and releases of hazardous wastes and toxic chemicals were contaminating the land and the ground water across our nation. The persistent use of pesticides and inattention to ecosystem protection threatened numerous species of plants and animals including our national symbol, the bald eagle. In response to those threats and others, our nation made a commitment, expressed in the National Environmental Policy Act, "to create and maintain conditions under which man and nature can exist in productive harmony and fulfill the social, economic and other requirements of present and future generations of Americans."

We all know that human beings and nature can exist in productive harmony. We can fulfill the social, economic and other requirements of this and future generations. That is what we mean when we use the phrase "sustainable development." We want to meld our economic and environmental aspirations. We have come a long way in the last 25 years. Lead, for example, was a serious public health threat two decades ago. Now, because of government legislation and regulation, exposure to lead has declined significantly and the threat to our children has been reduced substantially -- although the threat is still there and more work is needed. And just yesterday in our Western Hemisphere summit meeting in Miami, every democratically elected leader of this hemisphere, from 34 out of the 35 countries, agreed to completely ban lead in gasoline throughout the Western Hemisphere. We have also made great progress in other areas, e.g., reducing exposure to pesticides, particulate air pollution, and industrial and municipal discharge of water pollutants.

Our regulatory system has led to the internalization of environmental thinking and concern in our industries. We changed the cost equation in the marketplace to include environmental impact as a factor. Today we have companies that go far beyond what regulations require. We have firms which undertake independent audits of their environmental performance and then proudly publish the results. And we have companies that work with neighborhood and environmental groups to solve shared environmental problems. In fact, the largest single economic development project in the state of New York is a partnership between an environmental group, the Natural Resources Defense Council, and some private companies to recycle paper in an area that needs jobs.

Yes, it is worthwhile to acknowledge all of the progress that has been made, but as we do so, we also have to soberly recognize how much farther we have to go. One-third of our population still lives in communities where the air is dangerous to the health of the people who are breathing it. And even though we made a commitment many years ago to clean up our rivers and lakes, more than one-third of our rivers and lakes are still unsuitable for fishing or swimming, including one not far from here. And there is more. Many of the problems that we face today are more subtle, more intractable, and more costly to solve. What is worse is that presently we are not tackling these problems effectively. In some cases, we just lack the technology to deal with our current problems. And as we move into the future, we have the even larger challenge of placing ourselves on the path of sustainable development.

To achieve sustainable development we must pursue a fundamental, technological transformation, a transformation that will allow us to focus our attention on anticipation and prevention, as opposed to simply reaction and remediation. We cannot continue to squander our economic and natural resources in the catch-up, clean-up game. Over the coming decades, the U.S. economy must be able to deliver high quality products and services to domestic and world markets with significantly less energy and materials inputs and a dramatic decrease in environmental impacts. As a nation, we must shift to fundamentally new technology trajectories rather than just increase our pace along the same old technological paths. The successful industries of the future will be those that have made this transformation in technology efficiency and productivity. They will make the shift from waste management to pollution prevention and to the efficient use of resources. They will become models of an industrial ecology built on a closer integration of our systems with nature's systems.

I have often used a simplistic analogy of the hunter looking for a bear but being unable to see it in the woods. As a result, the hunter follows the bear's tracks or gets a good hunting dog that can follow the scent of the bear. In just that same way, an industrialist who is looking for more inefficiencies to eliminate, having long since eliminated the most obvious inefficiencies, may be unable to find the remaining inefficiencies as quickly as his competitors. What does he do? He follows the tracks or the scent. The pollution turns out to be, more often than not, the most easily recognizable marker for an

inefficiency. Environmental waste is economic waste. Factories produce products and pollution. If one eliminates the pollution, fewer raw materials are consumed in producing the pollution. This revolutionary approach to efficiency goes hand in hand with our efforts to clean up the environment.

Of course, the new technologies that are applied directly to the task of clean-up are now being manufactured, sold, and purchased around the world in increasing volumes. The environmental technology industry is now one of the most promising sources of new, sustainable, and high-paying jobs in the United States with revenues estimated at $134 billion and more than one million jobs. Globally, environmental technology in 1992 amounted to nearly $300 billion in revenues. By 1997, it is expected to surpass $400 billion. Both domestically and globally, environmental technology means jobs, good jobs, and economic growth. We need better technologies now to clean up existing pollution. We need still better technologies for tomorrow to prevent pollution and we need to establish the United States as the world leader in the environmental industry. But we have some obstacles that we have to clearly recognize and deal with.

It is hard to recognize that anything could stop us because in the United States we seem to have everything we need. We have smart engineers, the best in the world. We have world-class universities and research laboratories and we have more than 45,000 companies in America which contribute to the nation's environmental technology industry. But we also have a regulatory system that lacks flexibility and is too cumbersome. Too often, technological change is stifled by overly prescriptive statutory and regulatory provisions. We need to find ways to encourage innovation, creativity and risk-taking. Pursuing more sophisticated environmental technology requires a more sophisticated regulatory system that is more efficient and more effective in our current competitive and technological landscape. Of course, we hear a lot today that the costs to industry of regulations are too high and, in essence, that economic and environmental policies are inherently in conflict. They are not. That is the wrong conclusion from the evidence. We do not need to choose either the economy or the environment. Protecting the environment can and must be good business, but not if we continue to squander our resources.

For example, look at the cost of cleaning up a hazardous waste site. Where are the resources going? We are spending too much time and way too much money in the courtroom litigating. We are not spending enough time in the field remediating. If protecting the environment is too costly in our current system, we are left with two choices. We can either lower environmental standards, because the cost of complying is too high, or we can find a better, more efficient way to achieve our goals. Taking into account the nation's youths, I hope that we can find broad agreement in our country that it is wrong to lower our standards and discount our children's future. The central problem is not the standards. It is the approach and the cost to achieve our standards. So the solution lies in fixing the system.

As I said earlier, we need to change the cost equation and change the way we do business. We need to reinvent the way we go about advancing environmental technology. The central premise of our efforts to reinvent government is that creating a government that works better and costs less will give the taxpayer the absolute maximum value for every tax dollar. In terms of environmental technology, that means developing statutes and regulations that promote innovation instead of stifling it. That means fostering partnerships between the private and public sectors. The next generation of environmental policy must stress flexibility with increasing accountability and environmental quality. Without flexibility, we will not innovate. Without accountability, we will not have the trust to work together. And without a commitment to increasing environmental quality, we will not achieve a sustainable future.

Consider again the cost of cleaning up hazardous waste sites. I remember when the Superfund law passed in December 1980. It was a post-election, lame-duck session of Congress, the last one until the 1994 session. Immediately after the law was passed, the new Administration came into power and was very hostile to environmental laws, at least at the beginning. The Congress distrusted the Administration. So each effort by the Administration to hack away at the new environmental law led to renewed efforts by the Congress to proscribe very detailed actions that the Administration had to take. By the time this process had run its course for several years, virtually all flexibility was taken out of the administration of the law. And that is expensive.

We have to go beyond that kind of approach. We have to rely more on trust between the executive and legislative branches of government, and among government, industry and environmental groups. Industry can play, in many ways, the key role in helping to build the kind of trust that will make possible flexibility and rapid progress. And we have to think more about incentives for the right kind of change. We need incentives for industry to go beyond the standards that have been set, to go beyond the best available technologies. We must harness American ingenuity to support the power of the free market system to work toward building a sustainable future. We must rapidly develop, demonstrate, commercialize and then quickly apply the technologies that can save our society billions of clean-up dollars. If we do not have the technologies that we now need, we should admit it and get to work advancing the technologies that can do the job more efficiently. And if we lack the regulatory system that we need, it is time we go to work and fix that as well. And we are doing that.

Last July, I released the report called *Technology for a Sustainable Future: A Framework for Action*, which lays out the key issues associated with the advancement of environmental technology. We asked the National Science and Technology Council to undertake a series of technical workshops and policy symposia around the country to learn more about the views of individuals in industry, academia, non-governmental organizations, and state and local government as to how federal policies and programs can be improved to encourage the advancement of environmental technologies. Central to this effort was the identification of public-private and federal-state partnerships to advance the development and commercialization of environmental technologies, whether involving avoidance, controlled remediation, or monitoring.

What we found is that partnerships really work. For example, Motorola, working with the Department of Energy, developed a wave solder process that entirely eliminates the need for cleaning solvents for the manufacture of electronic printed wire boards. If this process is adopted by the electronics industry, an estimated 11,000 tons of ozone-depleting emissions and 19 trillion BTUs of energy could be conserved. That is worth considering. Considering another example, each year more than 500 million gallons of spray paint are applied on surfaces. For every gallon of paint sprayed, about 4.5 pounds of pollution are released into the atmosphere. That is 4.5 pounds times 500 million every year. In response, the Union Carbide Chemical and Plastics Company, along with National Science Foundation researchers working at Johns Hopkins University, are developing spray paint and coating technology that reduces emissions by some 80 percent. Furthermore, the new process not only causes less pollution, it also costs less in labor and improves the quality of the final product. How many people here have had similar experiences in finding that innovations that are designed to reduce the amount of pollution end up providing a bonus in that they cost less and provide higher quality products and services? Such results often go together, not just sometimes, but often.

A final example of the partnership approach that we are taking involves the partnership to create a new generation of vehicles. The Big Three automobile companies, along with the Departments of Commerce, Defense, Energy, and Transportation, the U.S. Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, and the White

House's Office of Environmental Policy are all working together to create the car of the future. With a prototype car planned for the year 2004, the goal is a three-times increase in fuel efficiency with the same or better performance at the same or better price as current vehicles. The potential is absolutely enormous and the level of excitement is very high in the industry and among the other participants.

There are many more success stories that I could also cite, but what they all have in common is that they epitomize what is best about our country when we really decide to solve a problem. Our goal must be to employ ingenuity and cooperation to make such examples the rule rather than the exceptions. That means that we are going to have to focus on a different set of incentives, on a different way of evaluating success and monitoring performance, and on a different relationship between the government and the private sector. And we are going to talk about all of that during this conference. We have to move beyond our current command and control regulatory system to a new paradigm that rewards creativity and risk-taking and strives for efficiency through innovation. This is the way to transform our activities from catch-up and clean-up to prevention and avoidance. This is the way to bring together the expertise and resources of the public and private sectors to achieve technological transformation in the environmental arena and to build a more competitive economy.

We are reexamining our regulatory programs to find ways to encourage greater innovation and use of environmental technologies. We are working with the states to find ways to speed up the regulatory permitting process and we are developing verification programs to help technology developers achieve the independent performance assessment they need to commercialize their technologies in a timely fashion. With programs like Climate Wise and the Common Sense Initiative, agencies like the Department of Energy under Secretary Hazel O'Leary and the Environmental Protection Agency under Administrator Carol Browner are already building new alliances with industry to improve environmental performance by corporations through voluntary actions. The National Science and Technology Council has critically examined federal research and development programs and developed a comprehensive strategy to ensure that federal programs are well-coordinated and directed to the long-term needs of the public and private sectors.

We have developed and are implementing an aggressive government-wide environmental technologies export strategy. We will build on our national and global information infrastructure. We are creating a global information network for environmental technologies designed to support collaborative work on new environmental solutions and to help connect innovations with capital and markets. In fact, through the Internet, we will be exchanging ideas with colleagues around the world throughout this conference. And we are working around the world to expand environmental management capacity and programs. We are finding eager partners in the rest of the world.

And finally, we are working with a range of stakeholders to speed up the commercialization process. Today we are undertaking a new initiative that will help technologies move more quickly from R&D to commercialization. The goal of this effort, the Rapid Commercialization Initiative (RCI), is simply to ensure that good ideas for environmental solutions reach the market quickly, i.e., bridging the gap that too often limits the advancement of promising environmental technologies. We will do this in a number of ways, such as increasing the availability of federal sites for technology demonstration and testing, and working with the states to streamline the permitting process. We also are establishing a one-stop shop for information on federal environmental technology programs. Through the Interagency Environmental Technologies (IETO), experts can share information with individuals and organizations within and outside government. Commerce Secretary Ron Brown will discuss the RCI in more detail later in the conference.

In closing, let me say that I have long believed that the global environmental crisis is actually a manifestation of a dramatic change in the relationship between human civilization and the ecological system of the earth. The change in that relationship has been produced by a combination of three factors: (1) the population explosion; (2) the scientific and technological revolution, which, for all its blessings, has also increased humanity's power to affect the environment around us and has sometimes led to unintended damage; and (3) a new way of thinking which has allowed too many people to believe they can simply ignore the consequences of today's actions for tomorrow. We need to address all three of these challenges.

We took an important step forward in our world with the achievement at Cairo earlier this year of a worldwide consensus on how to stabilize the world's population. This environmental technology conference may ultimately be looked back upon as being even more important if it helps to catalyze the development, demonstration, commercialization, and wide diffusion and application of new environmental technologies. We will clean up the environment and create jobs at the same time. Our world has changed a lot since that day when Neil Armstrong radioed back "the Eagle has landed." It continues to change quickly.

Our environmental policy must reflect and respond to the changes in our world. We need a paradigm shift in our policies toward the environment and the economy. The huge factor that has led to the environmental crisis, our way of thinking, is where the most work needs to be done. We need to change the environmental, energy, and economic equation and devise ways to take advantage of the tremendous forces of the marketplace to achieve our objectives. Most importantly of all, we need you, each and every one of you, to help. It is time to change the system, yes, but we need your skill, your ingenuity and, most of all, your commitment because you are on the cutting edge of technological advancement. It is our job in government to give you in the private sector the opportunity to do what you do best.

This conference is designed to help develop a national strategy that will enable us to do just that. Together, we can and will make the future brighter for everyone because it is the collective decisions of more than 250 million Americans, and more broadly, of 5.5 billion individuals worldwide, that ultimately will determine our progress toward sustainable development. In the quest to understand our universe we have learned more about ourselves. And as we understand more, we realize that our destiny lies in protecting the ecological system which sustains our lives.

As President Kennedy once said, "it is our task in our time and in our generation to hand down undiminished to those who come after us, as was handed down to us by those who came before, the natural wealth and beauty which is ours." Let us use science, technology, education and partnerships to fulfill this task and along the way create jobs and strengthen our economy. That is the strategy that will benefit us today and benefit the generations of tomorrow. Thank you for your role in making this possible.

Address by Ralph Peterson
Chief Executive Officer, CH2M Hill Corporation

Introductory Remarks by John Gibbons: Ralph Peterson is the Chief Executive Officer of CH2M Hill Corporation, the nation's largest environmental consulting, engineering, and remediation firm. As Co-Chair of the Colorado Environmental Business Alliance, he has worked to build partnerships among companies in the environmental industry and also with other private and public sector organizations. In addition, he co-chairs the National Congress for the Advancement of Minorities in Environmental Professions.

Ralph Peterson: As an engineer and businessperson, let me begin by sharing some of what I think are some important numbers that are going to affect each and every one of us. All of you here today probably know a lot of numbers behind the concept of sustainable development, and you probably believe the numbers are important or you would not be here. But what is less clear from the statistics is how they form the basis of an economic framework that will shape the future of American business -- and not just environmental technology businesses like the one I head, but also of manufacturing and process industries, the clients we serve, indeed, the private and the public economic structure of the nation.

As the Vice President said, the current population of our planet stands at roughly 5.5 billion persons, all of whom manage to survive on a total land area of about 58 million square miles. Think about two points. First, of this 5.5 billion persons who inhabit the planet, the majority of them live under what are, frankly, frightening economic conditions. Indeed, more than a billion of those people somehow survive with a per capita income of less than a dollar a day. So, the level of global industrial and economic growth that is going to be needed to meet even the most basic needs of the present population is enormous.

But, secondly, the experts tell us that over the next four or five decades, the world population is likely to reach about ten billion people. To provide even the most basic living standards for a twice the present size world population is going to require a level of global economic and industrial development that is maybe five to ten times today's level depending on exactly how one defines "basic" and how one defines a "standard of living." And while all of this population growth and industrial and economic development is racing along, the land surface area of our planet is still 58 million square miles. We simply must recognize that land, water and air allotted to human endeavors on this planet are never going to expand.

This situation tells me that sustainable development is a whole lot more than a theoretical notion. Whether it be in the effect of the price and cost of the products we use or the products and services we sell or the quality of our lives or the more dire circumstances and results of disease and starvation, every person on this planet has a personal stake in the successful melding of those economic and environmental aspirations about which the Vice President just commented. In plain economic terms it means that we will either find a way to manage the sustainable development of our finite world, or our finite world will increasingly manage us.

Now, in the economic and business context, this tells me that technology for a sustainable future will, in fact, be a fundamental basis for economic development. Successful innovation by which we will advance technology will increasingly define the competitive advantage of companies and even of countries. Our economic future as businesses and as a nation will depend on us getting this right.

Now let me state emphatically that I am optimistic about what this means to all of us in this room and all of us in this country. It is, in fact, within our power to meet the challenge of a sustainable future including delivering on its economic promise for our children and for our children's children. And the main way to achieve that sustainable future, as the Vice President suggests, is through the cooperative and coordinated efforts of private enterprise, government, academia and public interest groups to shift to those, I believe his term was, new technology trajectories.

That is a good term because we need technology trajectories that are focused on tomorrow's needs, not yesterday's; trajectories that are going to make us competitive in tomorrow's marketplace; and trajectories that are based on new alliances that can break through the long-standing adversarial paradigms that needlessly divide us. One of the reasons why I am optimistic about the collective future is the mounting evidence that a lot of alliances that we are talking about are already beginning to take shape.

Here in this country, for example, the trend in industry is quite clear. It is toward finding common ground among businesses, the public, and environmental interests. An example that comes to mind is the linkage that Georgia Pacific and the Nature Conservancy have formed which has moved far beyond their past differences to collaboration to preserve critical habitat and provide long-term and stable business growth. You can see the trend in the breakthrough innovations like wetland banking that protect and expand wetland preserves while accommodating vital and needed port and shoreline development.

An alliance which is coming together in my home state of Colorado is focused on at-risk youth. This very promising public-private partnership, which interestingly is a direct result of the launching of the Administration's Technology for a Sustainable Future initiative, involves several federal agencies, state and local government, and the Colorado Environmental Business Alliance in advancing training, education and jobs in environmental business.

You can see the trend in the new generation of manufacturing processes that have environmental considerations designed into them from the start. I think that as time goes by these alliances and paradigm shifts will become the rule rather than the exception. Now, of course, some critics and cynics are going to argue that while it may have been possible at some past time to develop solutions and approach issues from a shared community perspective, our current combative political and economic situation no longer supports that kind of an approach.

They might question that, after years of regulatory and other feuds and political skirmishes, is it really reasonable to think that government and industry and civic institutions can in fact work in concert to advance the long-term common good and global good? I suggest a lot of that is happening right under our noses, maybe on a grander scale than we really realize.

Years from today, I will bet you that someone will address an audience like this and will reflect back to today, to this year, and they will talk about the profound impact of the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT) on sustainable development. Here is what I say to that. Today in Mexico and Latin America, for example, companies such as the one I lead are finding opportunities to share and apply environmental technologies in ways that simply did not exist before.
By dismantling long-standing trade barriers, U.S. environmental expertise and technology combined with global financial resources and a more empowered local citizenry are making momentous progress toward environmentally responsible economic development. And if you think about what

that could mean, just imagine providing a new generation of industrial ecology and environmental technology to the economic development of Mexico, Latin America or the rest of the world. What we are talking about is a whole new global economic composition.

This past summer I participated in China's Agenda 21, a national conference aimed at setting the sustainable development framework and policy agenda for that giant nation in the new millennium. And elsewhere around the world the story is the same.

In this new global composition, we in the United States have a lot to contribute technologically, economically, and environmentally. In fact, we have tremendous strengths in the environmental area. We have technical know-how, application experience, and outstanding services and products all reflecting strengths that have been gained through both successes and failures in dealing with our own environmental agenda. But it is still my very strong sense that we do not yet have it together to deliver our full potential either here at home or abroad. Jack Gibbons mentioned that one plus one can equal four.

The best analogy I can draw is that of an orchestra. In this analogy, we as a nation have an impressive array of musical instruments. We have some truly outstanding musicians. But what we are still missing is the orchestration and maybe the right downbeat to set this "economic symphony" (to use Maurice Strong's term) into motion. To me, this conference is about shaping that orchestration, doing so by developing sound policy and by fostering the public-private partnerships that we hope will continue to evolve.

It is not going to be easy to get the job done. Those of us whose companies have grown up and evolved under the command and control regulatory-driven marketplace are, frankly, going to have to learn some new ways of doing business. But if we fail to respond to the new economic realities, we will ultimately be replaced by those who have responded. I believe the Vice President and his team working on this environmental technology initiative truly deserve our thanks and praise for their willingness to take on many difficult issues.

The regulatory reform concepts that the Vice President spoke about -- such as aggressively pursuing sometimes contentious public-private partnerships, and breaking down the arms-length and often adversarial barriers -- take a lot of political courage. Thus we owe a debt of gratitude to them because they are going to help us build a better future business-wise and otherwise.

At the beginning of my address I made a point about my engineering and business background and my "hard numbers view" of sustainable development. Let me leave you with a different look at those numbers I cited earlier. When I spoke about the population and the economic growth data, the statistics that I found the most compelling were about the billion fellow human beings who are currently existing on less than a dollar a day. I am drawn to that information because I really know and believe that if we unleash the full force of American environmental and technological know-how, we can have both good business and good jobs and we can make an immediate and profound impact on those people in the world who struggle the most in their day-to-day existence.

This point really came home to me personally during a recent visit to Egypt where our company had the good fortune to have provided engineering services for Cairo's new water system. As I was touring the water facilities, I found myself on a hilltop in one of the oldest sections of the city. As I stood there late in the day, I looked out across the area below the ancient city and the old homes and the ancient mosque. From that vantage point it dawned on me that for the first time in the history of the great Egyptian civilization, the people living in the city before me were about to share something

that we take for granted every day, i.e., the experience of turning on clean running tap water in one's home. At that moment the importance of the economic significance, and indeed, the inevitability of sustainable development in very human terms, was never more clear to me.

So, as a people, as a nation, as entrepreneurs, as environmental advocates, as teachers, as civil servants, we in the United States have a great many inspiring moments in store for us as we chart those new technical trajectories that the Vice President talked about to build our sustainable future. And this conference is a great opportunity for us to help shape how we as a nation will participate in a future global economy in which technology for a sustainable future will be a, if not the key, competitive difference.

This is our chance to build a bridge to the vision that Vice President Gore described. As I am sure is the case with all of you, I certainly am committed to doing everything I can to make it happen. More importantly, I am convinced that together we can see that it gets done.

Address by Howard Dean
Governor of Vermont and Chairman, National Governors' Association

Introductory Remarks by John Gibbons: It is my great pleasure to introduce Howard Dean, the Governor of Vermont. He has served as Governor since 1991 and before that he was the Lieutenant Governor and served in the Legislature. Before he entered politics, Governor Dean served as a medical internist. I am reminded of Thomas Jefferson's statement, "Sir, my profession is politics, but my passion is science." We applaud the way that you are bringing your past passion of medicine and health care to your office as Governor; your being chosen by your peers to lead the National Governors' Association; and your leadership role in health care, education, community services and, of course, environmental protection.

Howard Dean: I am pleased to be here, both as Chairman of the National Governors' Association and as the Governor of Vermont. We are a very environmentally conscious state, but we have debates about regulation, about attempts to put partnerships together, and most of all, about trying to find out whether technological advancement and industrial progress are indeed partners or enemies of regulation and environmental preservation. And we conclude that they have to be partners. We have no choice. I think the statistics presented by Vice President Gore and Ralph Peterson about population growth trends and the tremendous pressure that population is going to put on the global environment give us no choice but to make industrial progress. The question is: How can we do that without endangering the environment?

Much of Vermont's economy is based on natural resources. We are strongly dependent on farms and forests, not just because there is money in natural resources, but also because our economy is highly dependent on tourism. Visitors to our state like to see those natural resources. Thus it is extremely important for us to protect the environment. Protecting environmental resources is important for our economy. The challenge is to find ways to continue to provide for jobs and economic growth while we are protecting natural resources.

A recent report published by the National Governors' Association entitled *Cultivating Green Businesses* highlighted the opportunities of green technologies. The report cited the need to make available information about markets for business and technologies, and to establish networks among key players to foster environmental businesses. These activities are extremely important and public-private partnerships can play a major role. I am proud to say that, as Vice President Gore noted, this conference is being simultaneously transcribed on the Internet. This is being done by the TogetherNet Foundation from Burlington, Vermont. Networking is obviously very important. Conferences like this are very helpful, and there are numerous examples of similar conferences where people have met each other, done business together, and furthered both environmental protection and industrial advancement.

The report also cited the need by environmental businesses for assistance in competing in foreign markets. I cannot stress strongly enough how important the General Agreement on Tariffs and Trade (GATT) and the North American Free Trade Agreement (NAFTA) and any further expansion of NAFTA are. You may remember that the ancestry of NAFTA was the Canadian Free Trade Agreement before we brought Mexico in. That happened in the late 1980s. In the first three years after that happened, Vermont's exports to Canada doubled. Vermont's exports to Canada are now about the same as those of Massachusetts even though we have one-tenth the population. Of course being right across the border from Canada makes a big difference. In any event, as soon as trade

barriers come down more people do business. This means more jobs, both in Vermont and in Canada. In the case of GATT and NAFTA, it will mean more jobs around the world.

Free trade is a very good thing for environmental protection. If you think the United States has problems with a third of its waters being non-potable, imagine the problems of the Third World. The U.S. environmental technology industry, which is the best in the world, now has the opportunity to compete well in foreign countries. Helping U.S. environmental businesses to compete in foreign markets, and helping to finance environmental technology development by our small businesses, are critical needs. There have been excellent things done in some of the states. For example, Alaska and New York put up money that helped small businesses with excellent ideas and excellent technology to move ahead. Providing such assistance is a critical role for the federal government, and for the new Congress.

While we are soon going to see much discussion about getting rid of many regulations and even abolishing some federal agencies (e.g., the Small Business Administration), I think it is extremely important for policymakers, whether they are Republicans or Democrats, to not get rid of particular regulations or agencies until they examine how they have worked. Small states like Vermont or South Dakota are not going to be able to compete if we get rid of the federal role in helping small businesses and emerging technologies. Alaska with its oil resources can compete. New York, with a huge population base relative to other states, can compete. The states with relatively small populations, however, are simply not going to be able to compete without federal help. That means that some federal agencies need to continue to function because they are extraordinarily helpful to states in fostering and supporting technology.

Supporting recycling technologies and markets is absolutely critical. Regulations can be helpful in this regard. About four or five years ago we passed in Vermont laws that required a certain amount of trash to be recycled. We did this for environmental reasons. What that did was to increase, ultimately, the cost of disposing of trash in landfills and incineration. And that, essentially, forced technology. Over the last few years there have been many technologies and many companies which have benefited immensely by that. And recycling has gone from being kind of an on-the-fringe notion that people like me followed when we were in college because it was a good thing for the earth, to something that major corporations all over the country are doing.

We have just located the fourteenth plant of an extraordinarily successful plastics manufacturer that makes culverts in Vermont. The fifteenth is now going into Texas. This is a privately held company which has an extraordinarily successful record. It makes plastic culverts that are so strong that my guess is they will replace most aluminum, concrete and steel culverts over the next 20 or 30 years. The culverts are so light that any one of you in the audience and I could set a 24-foot culvert across a road. Fifty percent of those culverts are made with recycled material. Why? Because it is available and cheap. The success in recycling was begun because of government regulation. But ultimately, after the creation of a market for the products, it has now become a way of life for major corporations with tremendous industrial applications.

Let me give you another example. IBM Corporation has the biggest chip manufacturing plant in the country in Essex Junction, Vermont. IBM uses just about every element on the periodic table to make its products. Over the last three years, they have decreased the toxins that they put in the air by over 50 percent -- a remarkable achievement. They did it to save money. They recycle a lot of the products they use now instead of venting them either into the air or the water. Why did this save money for IBM? Because the federal government and the state government established regulations and standards that meant it would be very costly to continue putting those chemicals into the air and into

the water. In other words, by setting standards, government changed the markets and then the free market responded.

So, to say that we are going to deregulate everything and let the marketplace decide how to clean up the environment is a mistake. Instead, we need flexibility in regulation. We do not need to get rid of standards. What is happening in environmental technology today is that, because of regulation and standards, we are simply now, for the first time, realizing the true costs of making products because the disposal of those products is now incorporated into the pricing process. That has to continue. Thus we need to initiate regulatory reforms.

On December 9, I and other governors met with Carol Browner, the Administrator of the U.S. Environmental Protection Agency (EPA), and she gave us some very good news. Here is an example of exactly what government should be doing. When the Clean Air Act was passed there were a number of tough standards that were promulgated to control air pollution. We, and industry in general, have done a terrific job cleaning up stationary sources. We have achieved major reductions although it has been tough and expensive. In large part it has been a very successful story, although we clearly have more to do. It also is very clear that if we are serious about job creation, stationary source pollution is going to gradually increase. This is because even after cutting eighty percent of the stationary emissions, when you have growth, emissions will continue, albeit from a much lower baseline. It is much more effective to go after mobile sources -- an approach not pursued much in the past decade.

Now the Enhanced Inspection and Maintenance Program is designed to reduce stationary source pollution. Congress and the EPA not only set the standards but they proscribe the exact technology we would have to use in order to meet those standards. I am not going to go into the details, but basically, if any of you are from Maine, you know what the imposition of that technology meant. During an election year the papers were full of stories of disgruntled customers waiting in lines for hours trying to get their cars inspected using a technology which was so expensive that there could only be very few inspection stations. That was a disaster. Many other governors, not wanting to experience similar disasters in an election year, went to the EPA Administrator and said, "We cannot continue to have this." And what the EPA said was, "We will not lower the standards, we will get rid of the proscription that you have to use this technology. You may use cheaper ones and we will give you a lot of flexibility in how to meet these standards, even going back to stationary sources if that is what you think you need in your state."

That is my idea of the kind of regulatory reform which helps a tremendous amount. Consumers will be happier and they will accept the technology. The technology will be different and it will be more widely dispersed leading to less inconvenience. But the bottom line is that the air will be cleaner and more jobs will be created. Those are the kinds of regulatory reforms that we really need to see.

Let me give you one other example. To deal with the Clean Air Act, Vermont and some other northeastern states were each permitted to set up an Ozone Transport Commission in order to reduce mobile sources so that we could increase jobs in industry by increasing stationary source emissions. The automobile industry is pushing the so-called "forty-seven state alternative." They said, "Look, don't force us to sell electric cars that we can't sell because they are too expensive. Don't force us to do that. We will be willing voluntarily to build a car that is substantially cleaner, not just to be used in the northeast, but to be used all over the country with the exception of California, Massachusetts and New York which already have existing statutes requiring mandatory sales levels." My own view is, terrific! Let's go for it! Let us work out the compromise. But, I believe that though we need to move away from the mandatory sales provision of that forty-seven state proposed compromise, we

must still have some regulation or target which forces technology. Remember the examples I used about recycling and about IBM. The forty-seven state alternative is terrific. It unshackles industry from mandatory sales quotas that we know are not going to work. But the forty-seven state alternative will never advance the technology of electric vehicles unless there is some recognition by industry that there must be regulatory forcing of technology in some way. So there must be a balance.

Life is a balance. Extremes end up not working because they are often ideologically based and not based on practical, reasonable experience. The next two years will mean an exciting time for both Democratic and Republican governors because there will be more responsibility passed on to the states. And I hope there also will be more regulatory flexibility for those in industry. But as we move forward in the next two years, let us not eliminate all of those things that we are suspicious about until we have decided whether they worked or not. George Santana said, "Those who do not learn from history are doomed to repeat it." I understand that Newt Gingrich, the new Speaker of the House, is a student of history. I hope that he will understand that there have been some very successful things that have been done, both in the private sector and at the state level because of regulation. I hope he will recognize that as we are moving towards less government interference we should not remove government entirely from roles in improving environmental technology and in helping to create associated jobs in this country and the world.

Address by Jonathan Lash
President, World Resources Institute
Co-Chair, the President's Council on Sustainable Development

Introductory Remarks by John Gibbons: Jonathan Lash is President of the World Resources Institute, a non-profit center based in Washington, D.C., focusing on research and development in environmental and energy policy on a global basis. He was appointed by President Clinton to serve as the Co-Chair of the President's Council on Sustainable Development. He has long been a leader in the environmental field, including through the Natural Resources Defense Council and the Vermont Natural Resources Agency, and while serving as the Dean of the Law School of the University of Vermont.

Jonathan Lash: I want to particularly recognize the work of Jack Gibbons and Mark Schaefer at the White House Office of Science and Technology Policy, and of the really remarkable interagency group that cooperated to prepare the July 1994 *Technology for a Sustainable Future* (TSF) report and to organize this conference. This initiative is an outstanding example of what can be done with very limited resources within government.

I am particularly pleased to have this opportunity to participate in this conference and to attempt to put environmental technology development in the context of sustainable development and the work of the President's Council on Sustainable Development (PCSD). In a month, the PCSD will meet in Chattanooga, Tennessee, a city which already has begun to put environmental technology advances to work. The essence of sustainable development is the integration of economic and environmental policies in order to allow us to produce more goods and services with less impact on the environment. Progress in environmental technologies, advances in the technologies of efficiency, and the substitution of intelligence, information, and capital for natural resource use and waste are indispensable if we are to even hope to achieve the goals of sustainable development.

It is useful to begin by considering what we mean by environmental technologies before we begin to discuss how we can achieve environmental technologies. The definition in the White House's TSF report is "hardware, software, systems or services that reduce risk, enhance cost effectiveness, improve efficiency or create products that are environmentally beneficial." The report breaks environmental technologies into four categories: those that control pollution, those that avoid pollution, those that monitor pollution, and those that remediate pollution. I think it is more useful, however, to look at the question in terms of the efficiency of the use of natural resources that is offered by technology and to create a hierarchy of technologies in terms of the value each type of technology offers to society in improving efficiency. Thus, the more efficient technologies are those that do more to substitute intelligence and information and capital for natural resources. The less efficient are those that do less. The least efficient is remediation. Controls are a little better than remediation. Process changes are better than controls and system changes are better than process changes.

By way of example, consider a refinery. My recent visit to India included a visit to the Taj Mahal which literally is being eaten by sulfur pollution generated by a nearby state-owned refinery with no controls. One approach to this problem would be remediation. Indeed, there are workers who go to the Taj Mahal and patch the marble almost daily. There is continuous work underway trying to remedy the effects of the acidification from the sulfur on the most beautiful piece of architecture I have ever seen. But of course it would be far more efficient and far more useful to simply install

scrubbers at the state-owned refinery. That would reduce the effects of pollution not only on the Taj Mahal, but on the entire region where pollution's effects on health are very high. Even more useful, though, would be to adopt the approach increasingly being used in the United States.

With regard to the refinery problem it is very useful to think about system changes that focus on the process by which oil is refined into gasoline -- and then working to modify that process so the elimination of pollution at the stacks simply is not necessary because it is never created. Many of the models that were mentioned by the Vice President, Governor Dean, and Ralph Peterson are of course examples of that kind of pollution prevention. Pollution prevention provides the tremendous benefit of saving materials. It enables us to be more efficient in the use of raw materials and energy. But, proceeding still further with this hierarchy of intelligence and efficiency, it also is useful to think about end uses.

What if were to develop a personalized advanced monorail-type transportation system that enables each of us to move rapidly and safely from our homes to the places we to need to go to? Such a system is under development. It would allow individuals to gain access to their own mass transit systems, and would vastly reduce the use of energy because it would sharply reduce the use of individual automobiles. This would be an elegant and efficient solution that offers great benefits to society. Reconsidering my refinery example, we should recognize that the best way to reduce the pollution from the stacks is not through controls on the stacks but by reducing the demand for the product of the refinery.

We also need to think even further down the chain of end-use to the use of the information superhighway instead of the Beltway. We need to move electrons instead of people, and allow people to get work done where they are and not require them to move their bodies around in order to complete their work. This would be a far more efficient and far more elegant solution than even rapid transit.

I suggest that this hierarchy offers important opportunities not just in reducing pollution and in increasing efficiency. As you move to the higher order technologies, those that substitute more intelligence, more information and more capital for natural resource use, you end up with technologies that are not only more efficient, but technologies that provide multiple benefits to society rather than the single benefit of environmental protection. It is more useful to us to prevent hazardous waste than to remediate it, and it is more useful to change the activities that generate it than simply to control it at the outlet. Such an approach is more useful to society in terms of economic goals and environmental goals.

Higher-order environmental technologies have proven to offer significant management opportunities. They are the key to the adaptation to the trends driving the future identified by the Vice President and by Ralph Peterson. And they offer enormous returns on investment. One company with which I have been working closely has calculated the returns on its control investments and its pollution prevention investments over the last several years. Concerning those investments that have been made simply to comply with environmental regulations, the firm has attained a minus 12 percent return on investment. Concerning investments made in pollution prevention, it has attained a plus 152 percent return on investment. Pollution prevention provides an enormous bottom-line opportunity, in most cases an even greater bottom-line opportunity than the creation of new products.

It is a premise of the White House's TSF report, and of the presentations of the speakers who have preceded me this morning, that for society to benefit sufficiently there must be a government role in promoting environmental technology. First, many of the benefits that are secure, the environmental

benefits, are non-market benefits. They do not show up in the price of products because prices do not include the environmental costs. Second, there already is an enormous governmental role through regulations which can either drive or obstruct technological change, through the enormous federal investments in environmental technology, and through military space and civilian research. Historically, government policy has had an enormous impact on choices of technology. I recently heard someone who had been involved in the origin of the semiconductor industry say that the billions of dollars of federal funds that the industry could use flexibly during its early development enabled the industry to grow rapidly. Further, as the Vice President and Ralph Peterson pointed out, our competitors are intervening in the development of these technologies. It is a very competitive world.

What can government do? It can push the development of technology through regulatory mandates. An example is the California zero-emission vehicle. That mandate, unpopular as it is with the manufacturers of automobiles, has led to an explosion in the development of practical, marketable electric vehicle technology. I was in California last week at the electric vehicles convention. Every major auto maker from the industrialized world was there with an electric vehicle that they intend to market, or in many cases already are marketing, in California. General Motors has developed a wonderful car that is fast, silent, reliable, costs one-fifth as much to drive than with an internal combustion engine, and can be recharged from central station power -- and it would reduce pollution by 50 percent. Another example of regulation that has driven change is the Montreal Protocol. Nations of the world agreed that it was absolutely necessary to reduce emissions of chlorofluorocarbons but gave industry wide latitude to determine how to meet the targets. The mandate has driven a rapid development of alternative technology.

In these examples, a performance goal was established for which practical technology was not available at the time it was established. The performance goal has driven technological change. The danger comes when we go beyond performance goals and established technology standards which, instead of driving technology, freeze technology. Most of our current conventional environmental protection laws are based not on performance standards, but on technology standards. There is a whole forest of different technology standards, e.g., best available controlled technology and best practical controlled technology. Lowest achievable emission rate turns out to be another technology standard. The removal of those kinds of obstacles has become one of the central concerns of the President's Council on Sustainable Development. We have recognized that simply by moving beyond those obstacles in the environmental regulatory system we will unleash a tremendous energy of technology development and improved efficiency in the United States.

There are other roles that the government can, and does, play. The use of government purchasing power offers a tremendous opportunity to drive technology. But in order for this to be successful, we need a strategy to overcome the massive inertia and single-mindedness of federal procurement regulations. Vice President Gore has played a big role in trying to break down that rigidity and allow greater freedom. We have to specifically say that one of the goals of procurement reform is improved environmental efficiency. It is not just in civilian research and civilian procurement that those opportunities exist, but also in the enormous military research expenditures. It is possible to pull technology through financial incentives.

The TSF report identifies a number of options with regard to supporting research through tax benefits. In this regard it is important to not to be too timid. We create wealth out of labor, capital and natural resources. Greater efficiency in our use of natural resources creates both economic benefits and enormous environmental benefits. That is the essence of what we achieve through environmental technologies, particularly higher-order environmental technologies. Perversely, of

course, we tax labor and capital and subsidize natural resource use. Over 90 percent of the trillion dollars-plus in taxes that the federal government raises comes from taxing labor and capital and less than 10 percent comes by taxing consumption and waste. Meanwhile, there are multi-billion dollar subsidies for the use of natural resources. That distortion means an appalling burden for technology to bear, since those who make decisions in the free market make decisions in their self-interest about enhancement of their bottom lines. What if we were to substantially cut the taxes on labor and capital? What if we were to encourage environmental technology by making it much more profitable to invest in capital and intelligence instead of natural resource use? And what if we were to cut those taxes, not just a little bit, but a lot, by shifting them on to consumption and waste? Think of the size of the incentive that could be created by moving some of that trillion dollars from capital onto waste. That is an enormous opportunity. It is one that is timely because there is so much discussion of tax cuts without increasing the deficit. It would be like a rocket booster under environmental technology.

I was very pleased when Ralph Peterson talked about the fact that he already sees examples of the kinds of partnerships and the kinds of trust that he and Vice President Gore say are necessary. I hope that the PCSD will be one of those examples. The Council includes nine corporate CEOs, six environmental leaders, representatives of other sectors of society, labor, civil rights, Native Americans, and five members of the President's cabinet, three of whom will speak to you this morning [Carol Browner, Ron Brown and Hazel O'Leary]. The PCSD is trying to address precisely the issues that have been raised this morning. How do we define our goals with sufficient clarity and sufficient consensus so that we can give much broader flexibility to those who would achieve them? How can we use intelligence to achieve the goals instead of prescribing outcomes? I am enormously optimistic about what is happening because of the last five years in which industry has been voluntarily undertaking enormous changes. A trust has been created that can become the basis of very significant progress. Indeed, my colleagues at the Environmental Defense Fund and the Natural Resources Defense Council have already become pioneers in developing those kinds of partnerships with regard to pollution control. My own organization has collaborated with a number of industries in developing studies on green accounting and providing better tools for industries to make necessary changes. And the PCSD has already identified numerous demonstrations of environmental technology at work fostered by the kind of trust that we have discussed. In conclusion, this is a time of enormous opportunity and this conference can be the basis to exploit this opportunity throughout the country.

Address by Stephen Trachtenberg
President, George Washington University, Washington, D.C.

Introductory Remarks by Carol Browner, Administrator of the U.S. Environmental Protection Agency: I want to congratulate Jack Gibbons and his colleagues on an incredibly successful event. I understand that instead of the 600 expected attendees well over a thousand persons are attending. This is a real testament to just how important these issues are and how significant the White House leadership on these issues will be in the future. We are here today to find common sense, cost-effective ways to ensure that economic growth goes hand-in-hand with protecting the health of the people of this country, our neighborhoods, our communities and the natural resources we all share -- our air, our land and our water. Institutions of higher learning are a vital partner in this effort. And today, it is my great pleasure to announce a partnership between my agency, the Environmental Protection Agency (EPA), and George Washington University (GWU), located just four blocks from the White House. To begin this very exciting partnership, we worked together to ask how GWU could become an environmental leader in all that it does each and every day. We looked at the university as a physical plant. How are the buildings heated and cooled? How does GWU deal with recycling, lighting, and waste disposal? We looked at the university as a health care provider, as a local community, as part of the neighborhood, as a research center, and as a consumer of technology. We also looked at the university as an educator -- at its curriculum, its training programs, and most importantly, at its capacity to train a new generation of environmental leaders and to promote environmental awareness among students, faculty, staff and community members. And finally, we looked at this university as a leader among institutions of higher learning -- not just in this country, but throughout the world.

So, today, the Environmental Protection Agency and George Washington University will sign an agreement to work together to make an environmental ethic a part of all activities at the university. I want to commend the university for wanting to be a leader among institutions of higher learning. And we are very hopeful that because of GWU's leadership, other institutions of higher learning will follow suit and will look at the best ways for them to be "green" -- and how they can best solve the environmental problems at their campuses and in their neighborhoods. Today's agreement is a truly groundbreaking agreement. George Washington University is a trail-blazing institution willing to tackle difficult issues, and to find common sense, cost-effective solutions that will work for the institution, for the city, and for this country. It is now my great pleasure to present to you Stephen Trachtenberg, GWU's President, who has made all of this possible. Without his vision and his willingness to set a very tough but important goal, we would not be here today. He is a true leader, a man of great wisdom.

Stephen Trachtenberg: I very much appreciate Administrator Browner's kind words. I am delighted to be able to speak at this very important White House-sponsored meeting. I want to personally thank Vice President Gore, Jack Gibbons, Mark Schaefer, David Rejeski and the whole team at the White House's Office of Science and Technology Policy as well as Administrator Browner and her management team and staff at EPA for this very special opportunity. I now want to talk about the roles that green universities can play in moving us towards a sustainable future. I will use the recent experiences and activities of the George Washington University (GWU) to illustrate some of these roles and to expand a little on Administrator Browner's introduction.

Universities fulfill their missions when they develop new paradigms, explore new directions and infuse their students with new and important ideas. They can go beyond society's expectations when

they take a leadership and a stewardship role in changing prevailing culture, creating new visions and affecting our world in creative and beneficial ways. At GWU, about a year ago, as you heard from Administrator Browner, we decided that we would become a "green university." We were not quite sure what that meant, I must confess, but we decided we wanted to do it and we wanted to do it in a truly comprehensive sense. I believe that this initiative may well exceed the expectations that many of you may have for institutions of higher learning. With regard to affecting cultural and other changes for a sustainable future, we concluded that there were five action areas.

The first was in our administration, our management, and our support services. The second was in all of our education, training and outreach programs. The third was in our research activities, whether we conduct them in the field, in laboratories or in other settings. The fourth was in the providing of health care services. And the fifth had to do with our facilities, our grounds, our own institutional infrastructure. As one of America's leading universities, we are well-equipped and positioned to take on these challenges. Our faculty, our staff and our students are culturally diverse adding to the richness of our capacity. We have extensive national and international education and training and outreach programs. We have a state-of-the-art analytical and research facility and we conduct a wide variety of research worldwide. We are a multi-campus institution with considerable additional development both under way and contemplated. In the District of Columbia, we are arguably the largest private sector employer. Additionally, GWU uses the services of more than 26,000 vendors. The approximately 31,000 individuals who make up our campus, faculty, students and staff have an economic impact on the local and regional economy estimated to be 1.5 billion dollars a year. We think of ourselves as a university that matters, one that is on the threshold of its 175th anniversary.

And so, when we first started our green university enterprise, we had some lofty ambitions about what we had in mind. Our students and faculty joined in with enthusiasm. Ranging from our undergraduate College of Arts and Sciences to our graduate schools for business engineering, medicine, law, the sciences and the social sciences including international affairs, the staff came forward to do their part. You will understand that these are key individuals within a university. They represent the thousands of people who plan and operate and maintain our buildings and our grounds. They buy our supplies and equipment. The response from outside the campus has been equally affirmative.

So it has not been difficult for me as the President of GWU to justify our activities in this regard to our diverse constituents and to our Board of Trustees. This is a case where the leadership role for me and my management team has come embarrassingly easy. To put it simply, we view this initiative as just plain good business. We believe that being an institutional leader in this area will give the university a competitive advantage in today's educational, research and health care marketplace. By strengthening our attractiveness and recruiting marketing and sales, by conserving precious natural resources, by cutting down on energy consumption and reducing our operating expenses, and generally by making our financial and other resources go further as we expand our available capital and operations, we will be creating new professional opportunities and generating new jobs. We also will be stimulating long-term economic growth, improving and sustaining the environment, and enhancing the health and wellness of our citizens. All of this makes us more productive and more efficient. It probably means that we can better control and keep reasonable our tuition rates, and provide us with more resources that our faculty members need in order to do their teaching and their research.

To facilitate all of these things we appointed a 50-member task force, with representatives from our student body, faculty, and staff to help to plan the course for our greening. We also invited federal and local government officials to participate. We are extraordinarily appreciative of their support.

The Director of the District of Columbia's Pollution Prevention Committee, for example, has participated in our task force. In addition, on campus we created an Institute for the Environment which cuts across the various colleges and schools and which serves to facilitate and coordinate our various intercollegiate initiatives. Getting departments and colleges and schools within a university to give up their prerogatives and their sense of turf is difficult. The task force and the institute are very helpful. Our goal has been to fully integrate the greening effort into our overall management and operations rather than have each individual department look after its piece.

As we started this process we began a conversation with various offices of the U.S. Environmental Protection Agency both at the headquarters and in EPA Region Three. They immediately helped us in the conceptualization and creation of our plan. They gave us technical assistance and a great deal of helpful information at our earliest meetings. At our invitation, senior EPA staff joined us on campus and helped us with our university decision making. Other federal agencies also became interested and involved. We have seized the opportunity to create a special synergy. Now we are formalizing the GWU-EPA relationship to which Administrator Browner referred. We have created what we think is a unique public-private partnership to create what we believe will be the first national model green university.

To advance our efforts we have recently developed relations with a number of organizations. For example, we are working with Public Technology, Incorporated (PTI), which assists local governments here and abroad on environmental and other technology-related matters. PTI is the non-profit research and development technology transfer and commercialization arm of the National League of Cities, the National Association of Counties, and the International City-County Management Association. Working through EPA, we are planning initiatives with the U.S. Committee for the United Nations Environment Programme (USUNEP), which is working with GWU to export the environmental technology products and other products and services that we generate with PTI and our other partners. Our work with USUNEP is targeted to reach state and federal-level agencies and non-governmental organizations in the United States and abroad. GWU and EPA also intend to coordinate with other colleges and universities to export models and information. GWU already has in place relationships with many educational institutions including some of the Historically Black Colleges and Universities. A number of environmental justice projects are also currently being explored. We are working with a variety of other organizations such as the National Wildlife Federation's Campus Outreach Division and the Student Environmental Action Committee.

At GWU we are fortunate to be able to build this comprehensive greening initiative on a well-established foundation of historic environmental activities. Some have been in place for many years. At GWU we offer over a hundred courses related to the environment in six different degree programs. Recycling efforts have been underway at the university for several years and we are a participant in the EPA's Green Light program. The university has for more than ten years used a number of alternatively fueled vehicles to transport various supplies around the campus. Several student environmental groups, such as the Environmental Law Association at the GWU National Law Center, are active on campus. We are planning to build another residence hall for our students and the GWU University Medical Center is proposing to renovate our current hospital and to build an additional facility. These construction projects are expected to employ a number of innovative environmental technologies and they will serve to demonstrate the application of some state-of-the-art sustainable development principles.

The letter of understanding and agreement between GWU and EPA provides an overarching framework for our collaboration with EPA and other agencies and organizations on projects of

mutual interest and benefit. It sets forth a number of broad objectives. While we have already made significant progress on the outreach aspects of our partnership with EPA, today at this conference Administrator Browner and I are formally announcing the signing of this historic landmark accord.

In closing, let me note that we seek ways to work together to change our cultural paradigms and to overcome the barriers that slow us in advancing behavioral, technological and other needed changes. Let us seek new types of partners and form creative new partnerships. Together, we can perform cutting-edge research, develop and test models, and commercialize and diffuse new and innovative technologies. Our sons and daughters, the children of our alumni, your children and mine in the coming generations, deserve no less than the very best collaborative efforts to safeguard and enhance their future.

[NOTE: EPA's Administrator Browner and GWU's President Trachtenberg signed the letter of understanding and agreement.]

Address by Hazel O'Leary
Secretary of Energy

Introductory Remarks by John Gibbons: Hazel O'Leary, the Secretary of Energy, plays an active role in promoting environmental concerns and in using the resources of the Department of Energy (DOE) to the ends so clearly espoused by the President and the Vice President. In particular, at DOE she has emphasized energy efficiency, renewable energy, technology transfer, and environmental restoration. And she has acted on these commitments in working to shift DOE's budget and, in fact, DOE's culture, toward environmental technologies for the future. I must also remind you that recently the Department of Energy, assisted by the Department of Defense, successfully brought to the United States from insecure situations in Kazakhstan enough highly enriched uranium to make two dozen nuclear weapons. This is one of the greatest adventures or escapades of the 1990s, which involved both Secretary O'Leary and the Vice President directly and personally. They deserve our congratulations. Hazel O'Leary is dedicated to achieving change and renewal. She is an ambassador for an efficient and open government and she is a personally committed advocate for environmental stewardship. It is with great pleasure that I introduce Secretary O'Leary.

Hazel O'Leary: I will begin by commenting on the Technology for a Sustainable Future workshops held this fall around the country. At these workshops business people and representatives from other groups have focused close attention on the question of sustainable technologies. A common viewpoint expressed at the workshops by industry representatives, for example, from the pulp and paper industry, has been that to get the job done industry seeks flexibility on the part of government. In the last year the Department of Energy (DOE) has tried to provide business with flexibility and taken other initiatives to help industry with regard to environmental technology.

Certainly, the flexible initiatives allowed in the Clean Air Act Amendments send strong signals to those who are ready to take advantage of a little freedom -- to take actions that make sense to their business. Flexibility is also inherent in the initiatives coming out of the Global Climate Plan, including Global Climate Challenge and Climate Wise. Many large industries with huge capital costs recognize that pollution and environmental responsibility are now bottom line business issues. As DOE's Joe Romm says, "if you can reduce pollution from inception, it pays." That is what we are all about. So, if the government can learn as we did in Climate Challenge and Climate Wise to simply set the performance standard, step back and let the business community step in, then we get a shot at unleashing a lot of creative thought. We have seem examples of that. We need a lot more of this kind of activity.

How do we do so? First of all, we do not step back from our embrace of the words "sustainable development." In these times of changed political agendas, many want to step away from the term. But sustainable development is about what matters. It is about economic development, environmental correction, and environmental protection. And it matters in the end. It matters in every part of the globe.

What else needs to occur beyond creating a regulatory regime that permits flexibility? We need to have coming out of this conference strong suggestions about how we look at individual facilities and apply performance standards there. We need some clear cut ideas and some criteria for changing standards.

How do you transfer this technology? I think I have a base of experience to talk about. You can focus simply on DOE's Environmental Management Restoration Program, though you might focus on any other federal agency which has a large environmental agenda which ought to be both science and technology-driven. We have been looking at this in DOE for the past 23 months. It turns out that what we have managed to do is to leverage government funding to privatize environmental technologies at about one to one: 50 percent government, 50 percent private sector. That is a good beginning but I know that we can do better. For example, our facility at Hanford which is now being built is to be opened up for the express purpose of inviting business in to participate in technological development which will address the clean-up problems at Hanford. We certainly need lots more technology to solve difficult problems.

At Savannah River, we have come from behind the fence to work closely with the private sector concerning the problems there. We established an environmental center to invite the private sector in to participate. Furthermore, this year DOE and other federal agencies which have responsibilities for environmental management and restoration have come together [in the Interagency Environmental Technologies Office] to invite the private sector in to participate. These are the kinds of examples of things that we need to stay focused on.

Most importantly, for the short term, we need to put ourselves in a position to call positive attention to be focused on those leaders in the private sector who have come to the table to participate in voluntary programs. Carol Browner, the Administrator of the Environmental Protection Agency, joins me today in recognizing some companies which have participated in a voluntary program which we call Climate Wise. The program focuses on large industrial and manufacturing facilities making commitments to reduce greenhouse emissions voluntarily. The companies being recognized were first at the table. I would point out to you that the utility industry brought more than 800 companies to sign these agreements. It is important to celebrate such private sector efforts.

[Energy Secretary Hazel O'Leary and EPA Administrator Carol Browner then presented awards to six companies: Dupont Corporation; AT&T; Johnson & Johnson; Martin Marietta; Phitzer Graphics; and Quad Graphics.]

Carol Browner Remarks at Awards Ceremony: I am grateful to Secretary O'Leary for the opportunity to work with the Department of Energy on the Climate Wise Program. This program is a very important component of the President's plan to protect public health and our natural world by reducing greenhouse gases. The companies that we are honoring today have all taken a very good, hard look at how they do business. And they each have made changes that make sense for them and for the environment. The changes will help them conduct their business in a cleaner, cheaper, and smarter way. Finding common sense, cost-effective solutions that work for businesses, for communities and for our environment is at the heart of the Clinton Administration's approach to environmental protection. The companies participating in Climate Wise have already made a commitment to reduce their emissions by over 20 million metric tons. That represents almost 20 percent of the entire Climate Change Action Plan. And the cost savings that they are achieving are truly remarkable.

Address by Ron Brown
Secretary of Commerce

Introductory Remarks by John Gibbons: Secretary Brown has been a strong advocate of promoting the export of environmental technologies to help illustrate the Administration's message that economic growth and environmental protection can go hand-in-hand. He also has been a revolutionary within the Department of Commerce to involve the National Institute for Standards and Technology to create public-private consortia in high-risk but high-social payoff endeavors. Under Secretary Brown's leadership the Department released its experimental export strategy just a year ago. And the Secretary has played a vigorous personal role in this activity, not only here at home with the Department, but in his travels overseas. It is with a great deal of pleasure that I introduce Secretary Ron Brown.

Ron Brown: I am honored to be with you, and very pleased to follow two stars of our Administration, Secretary of Energy Hazel O'Leary and EPA Administrator Carol Browner. We work very closely together. I also have the pleasure and privilege of working very closely with Jack Gibbons, who is playing such an important role in helping the Administration to focus on these issues. To tell you the truth, I had no idea that there would be a thousand people here today. This speaks very well of how far we have come -- and of the public-private partnership that we advocate. I think it is working. As we look to the future, it is an essential partnership if we are to be competitive in the 21st century.

It is terrific that we have arrived at the point in the United States where there can be a White House Conference on Environmental Technology. We remember the fierce debate that took place in our country not long ago between those who were focusing on economic growth and job creation on the one hand, and those who were focusing on our responsibility for the stewardship of the environment on the other hand. However, we discovered just a few short years later that we have a whole new sector of our economy called environmental technology that is employing tens of thousands, arguably hundreds of thousands, of American workers. I can see a time when environmental technology -- if we have a plan and a strategy and we implement them -- when environmental technology could be the biggest export that America has.

This shows how fast the world is changing. It means that we can no longer be satisfied in doing the things we have always done just a little bit better. We have to do a whole lot of new and different things. We need to think in new and different ways if we are going to meet the challenges of the future. No group of people recognizes this more clearly than those assembled here for this White House Conference. Environmental technology, as we know, is no longer just something we talk about in esoteric terms or in strictly scientific terms. It is very much a part of the changing economic and social agenda, not only of the United States, but of the entire planet.

President Clinton has clearly rejected the idea that we must choose between jobs and the environment. The fact is that we cannot enjoy sustained economic growth without a healthy environment. And the environmental technology industry will help to make this happen. Environmental technologies are not only a growth industry creating American jobs by selling innovative products and services around the world, they also contribute to a better quality of life for all of us.

The Department of Commerce is really the Sustainable Development Department. We have within our purview international trade and export promotion, civilian technology, and oceanic and atmospheric issues. We talk about economic growth and jobs and sustainable development and concern for the environment in the same breath, in the same sentence, so to speak. We know that it is important to understand that environmental technologies are really the driver of our efforts to create high quality, high wage jobs for the American people; to increase competitiveness among our businesses and expand exports; and achieve clean air, water and soil for our communities.

And so we are building the public-private partnership that puts the tools of growth into the hands of the private sector. The private sector has to lead. We in government can be better and more effective partners, but we are just that, partners in a supportive sense. The primary mission of my department is to work with you in the private sector to create even greater opportunities for American companies and for American workers. The development and commercialization of environmental technology by working in partnership with private industry is a cornerstone of our agenda. From the partnership for a new generation of vehicles, the so-called clean car initiative, to individual research grants and partnerships in advanced technology, the Commerce Department is working with private industry to support new environmental technologies.

Let me talk about just one of our efforts. That is the Rapid Commercialization Initiative (RCI) that Vice President Gore announced this morning. The RCI will be a high priority at the Commerce Department. We need to knock down the barriers that slow the commercial use of promising environmental technologies so as to reap the benefits of American innovation. In fiscal year 1994, the portion of the federal research and development budget that funds, or invests in, environmental technologies will exceed $2.7 billion -- with additional billions being spent privately. These are technologies that can create industries and jobs, that can save lives, and that can protect our precious natural resources.

But that will happen only if we can get the environmental technologies out of the laboratories and into the marketplace. We can do so expeditiously. The RCI is another important tool for ensuring that environmental technologies developed in the United States reach the hands of the private sector and, ultimately, the consumer. We are also working with the private sector to encourage the sales of eco-efficient technologies. In today's intensely competitive world, trade and technology are the new tools of American economic survival and, more importantly, prosperity. Trade is our single largest source of employment growth. Implementation of the North American Free Trade Agreement (NAFTA) alone helped to create a hundred thousand new jobs, and the General Agreement on Tariffs and Trade (GATT) is expected to boost American economic growth by 100 to 200 billion dollars a year creating hundreds of thousands of additional jobs.

There is a very simple equation and that equation is that American exports equal American jobs. I think we have not done a good enough job of communicating so that average Americans understand, relate to, and connect with all of this focus on trade agreements -- and our focus on implementing a national export strategy. But if you look at the data you have to conclude that, in fact, our economy is more and more export-dependent. Every one billion dollar increase in exports means 20,000 new jobs for the American people. So this is real. This is not just an academic discussion. This is about improving the lives of people. It is about raising standards of living. It is providing economic opportunity for people, not only here in the United States, but all around the globe. Environmental technologies will be a premier driver of this growing world trade.

The global market for environmental technologies is expected to reach 400 billion dollars per year by the end of the decade and 600 billion dollars per year by 2010. Over the years, the United States has

been a prime developer, as we all know, of cutting edge environmental technologies. In spite of that, our competitors in the environmental technology industry, primarily the Europeans and Japanese, export 20 to 30 percent of the environmental technologies goods and services they produce while we here in the United States export only an estimated five percent of our enviro-tech production. If the United States can increase the percentage of our output that is exported, it will support more than 225,000 jobs for the American people. I think we need to focus on this.

We know that we are number one in environmental technology. We have earned this ranking through hard work and through investment. We are not the number one exporter of environmental technology. The Germans, for example, do better at exporting environmental technology than we do and we have got to change that. We have to focus on ways to cause us to expand and grow. I believe that we can make this happen. From President Clinton on down, members of this Administration are carrying the message of American competitiveness to markets throughout the world. I have personally had the opportunity to lead presidential business development or trade missions to South Africa, the Middle East, Russia, Argentina, Brazil, Chile, Mexico, Venezuela, China, and Indonesia. In these trips we have participated in many environmental technology roundtables with foreign government and industry representatives and with the leaders of American environmental technology companies who have accompanied us. These countries are anxious to create the infrastructure of a growing economy. At every instance we have used the opportunity to promote sustainable development and the use of American environmental technology. This is very important.

It seems to me that the area that we are focusing on is an area where government policy can really drive demand. This is one of the few areas in which there can be this kind of direct connection. For example, when we are negotiating a trade agreement, whether it be NAFTA or the GATT, whether it be bilateral or free trade agreements, the more we emphasize environmental issues, the more we cause those countries to be customers of ours. Where are they going to look for environmental technology? They are going to look to the United States of America, the country that is number one in environmental technology. So there is a direct connection between the policies we promulgate and promote and what the demand is for the products that we manufacture and the services which we deliver. We think that we have not yet begun to scratch the surface. There is much more we can do working together, working in partnership with the private sector.

Let me give you just one example. This weekend marked the Summit of the Americas that received a good deal of attention. The stabilization of Latin American economies has opened the door to investments in environmental technologies. The value of the environmental market in Latin America is expected to reach 12 billion dollars by 1997. Significant markets will emerge in countries such as Argentina, Brazil, Venezuela and, of course, one of our primary markets now, Mexico. Our department has been working to ensure that our companies are able not just to compete, but also are able to win the competition.

Following our trade mission this summer to Latin America, the $1.4 billion C-Vam Project was awarded to Raytheon for technologies that will protect the Amazon rain forests. We supported the sale with every fiber that we had and the President wrote letters. I visited with the officials who were going to make the decisions on a number of occasions. I worked with the Raytheon executives. We believe that this kind of public-private partnership, supported by this kind of strong and hopefully effective advocacy, can really make a profound difference.

I know that we have to continue to work more closely with the private sector to build a closer bond. This is why we are creating the Environmental Technologies Trade Advisory Committee (ETTAC). Today I have the pleasure of formally announcing the committee and presenting the members to you.

The members come from 35 leading environmental technologies companies, both small and large, representing the full range of the industry's sub-sectors from throughout the country.

We have also established within the Commerce Department an Office of Environmental Technology Exports headed by Deputy Assistant Secretary Anne Alonzo. The office will serve as the liaison between ETTAC and our environmental trade working group. It is important that we pull all of these federal government resources together, and that I communicate effectively with the Secretary of Energy, the Administrator of EPA and others in the Administration like Jack Gibbons who are leading the way. That is exactly what we intend to do. ETTAC will play a very important role. It is essential that we listen to people who are outside of government. We cannot formulate policy without being good listeners, without knowing what happens out there where the rubber meets the road, so to speak. So we spend a lot of time listening and trying to be responsive to real concerns.

Some sixty years ago in major industrial cities like Pittsburgh and St. Louis, pollution was so thick that motorists had to use headlights in the daytime just to see. Unfortunately, that same kind of situation exists in too many places around the world today. American environmental technology helped us to dispel the darkness and, in fact, to let the sun shine in while providing economic opportunity for the workers of the world. The Clinton Administration is absolutely, unequivocally committed to creating a twenty-first century of sustainable development. We believe that we can produce the water treatment, the sewage treatment, the energy facilities and the infrastructure that will increase the health and safety and well-being of America's families and, in fact, of people throughout the world. We believe we can bring economic opportunity and stability to all. I very much look forward, as do all of us in the Administration, to working with all of you to assure a better future, not only for those of us in America, but for those all over the planet.

Address by Brian Atwood
Administrator, U.S. Agency for International Development

Introductory Remarks by John Gibbons: It is my pleasure to introduce Brian Atwood, the Administrator of the U.S. Agency for International Development (USAID). He took that job following a wide variety of experiences in government, both in the executive and legislative branches and in the Foreign Service. He is leading the Clinton/Gore Administration efforts in fostering sustainable development abroad, including in encouraging the use of the latest kinds of safer and cleaner technologies as countries around the world go through their industrialization and development.

Brian Atwood: Thank you very much, Jack, and thanks to you and your staff for spearheading this Technology for a Sustainable Future initiative that brings us all together today. This is an extremely important public-private initiative and USAID has been very pleased to participate in this conference and as time goes on, participate on a daily basis to foster that partnership.

This initiative is about more than just technology policy. It certainly is about more than picking winners and losers. Rather, it is about forging a common agenda among many groups, which together can play a key role in solving some of the major global and national challenges this country faces.

We live in a world of "posts": Post-Cold War, post-Rio, post-Cairo and post-GATT. The challenges we face reflect these watershed events. Our national security is no longer threatened by a single foe, but by a confusing mixture of localized crises and global trends.

Environmental conditions and population growth rates matter as never before to the health and safety of our own citizens. And we know that our own economic future depends on the growth of prosperous and stable societies around the world. USAID believes that a common thread weaves together solutions to these disparate challenges.

That thread is sustainable development. By sustainable development we mean broad-based economic growth that lasts, that does not degrade the environment, that helps to limit population growth, and builds open and participatory democratic governments.

We believe that sustainable development abroad is the best investment we can make to reduce the security risks of political and humanitarian crises. It is the surest way to stem degradation of the global environment. It is our best hope to limit population growth, AIDS, and the spread of other deadly diseases. And it is our best strategy to create new markets for American goods and services.

We gather together today because we know that technology is critical to sustainable development. We know that environmental degradation is a product of three factors: growing populations, growing economies, and the technologies they employ. If societies around the world are to provide better lives for their people and if these gains are to be sustained in an ever more crowded world, we simply must develop and employ cleaner, greener technologies.

Many of you know that protecting the global environment is one of USAID's top priorities. We see it as closely linked to our other sustainable development goals. Our environmental strategy, which many of you have helped to shape, focuses on the global threats of climate change and biodiversity loss and it addresses local and environmental priorities in each of the countries where we work.

Problems being tackled vary widely from dirty air and water to the inefficient use of energy to unsustainable agricultural techniques to the loss of forests, coral reefs, wetlands and other productive ecosystems.

USAID's approach to all of these issues involves finding and promoting the best technology. We define technology broadly to include hardware as well as software, the human and institutional capacity for environmental management. And we remind ourselves that finding the best technology sometimes means going back to the future, recovering traditional management practices that have stood the test of time.

Our search for the right technology naturally relies on partnerships. Our primary partners are the governmental, non-governmental and community organizations in our host countries. These groups must be the leading agents in their own development. I have directed our field missions to look to these groups first to help us set priorities, design programs and select technologies. But our American development partners are no less important. We are, after all, the United States Agency for International Development.

We seek to bring to bear the best that this country has to offer toward meeting the world's development challenges. And in the environmental field, that means working with you in this room from the business community, the environmental community and other government agencies. We need to work with you for two reasons.

First, although I have a great deal of pride in USAID's technical expertise, we do not know everything. We need to draw on your expertise. Thus, we have created a new environment center in our global bureau to be our primary technical link to you and your organizations. The leadership of the global bureau and the environment center will be working closely with you during this conference.

Second, USAID's long-term goal is to work ourselves out of a job. As nations develop, their need for our assistance declines, or should. We are already in the process of closing 23 country missions in Africa, Asia, and Latin America. In some of these countries, we achieved measurable success. In others we left because the government did not permit us to establish a full partnership with the people, the true beneficiaries of our assistance.

In the future, a key measure of our success in other countries will be the establishment of lasting partnerships between citizens, environmental businesses, non-governmental organizations, and government agencies -- from both the host country and the United States.

I want to describe a shift underway in our environmental programs at USAID. I mentioned earlier that we respond to environmental priorities at the country level. In the developing world this has led us, over time, to focus on the green agenda of natural resource management. We have developed and maintained strong programs to conserve biodiversity and natural resources.

But in many of our traditional partner countries, especially in Asia and Latin America, rapid economic growth and urbanization are creating serious pollution problems. The "brown agenda" of pollution and energy is becoming a high priority. You have heard the troubling statistics. Over half of the world's poor will soon live in cities, most with inadequate sanitation and shelter.

Air and water pollution levels greatly exceed World Health Organization standards in most developing countries. Rising energy consumption soon will make the developing world a leading

source of greenhouse gas emissions. As the "brown agenda" becomes more important in our partner countries, USAID expects to launch new efforts to address it.

In Latin America and in the Caribbean, we plan to strengthen our focus on urban and industrial pollution and on energy production and use. We will be guided by and will seek to help implement the environmental agreements reached just this past weekend at the Summit of the Americas in Miami.

In Asia we plan to increase our support for energy efficiency and renewable energy since inefficient energy use in this region is a major source of greenhouse gas emissions, a leading cause of local environmental damage, and a restraint to economic growth. Energy efficiency and renewable energy will be increasingly important strategies for sustainable development. We work in many cases through the Asian Environmental Partnership to make sure that not only is American environmental technology available to Asian partners but also that they have the best possible technical advice as to how to use it.

USAID's newest partners are in the former Soviet Union and in Central and Eastern Europe. The "brown agenda" is without question our top environmental priority in this region. Our programs there already emphasize pollution prevention and control, energy efficiency and the development of governmental and non-governmental institutions to pursue these approaches. Because these programs directly focus on the health and empowerment of the people, they play a critical role in breaking the psychological barriers erected by years of authoritarian Communist rule. This is integrated sustainable development in action.

As USAID increases its focus on pollution and energy issues, we anticipate that our programs will stimulate greater demand by the developing countries for American environmental goods and services. As you will be discussing here today, the United States has a competitive edge in many environmental technologies. I trust that you will be discussing ways to enhance that edge. And I would remind you that 70 percent of all of the goods and services purchased by USAID are American. USAID sees an important role for itself in building markets for U.S. environmental technology.

It is important to note that ours is a critical but limited role in the Administration's overall environmental export strategy. We work on the demand side. We help to develop long-term environmental trading partners through our efforts at institutional development, training, policy reform, and demonstration projects. These programs respond to the environmental priorities in the countries where we work.

We also can and do provide important information to the U.S. environmental industry about market conditions and export opportunities in our partner countries. And our Center for Trade and Investment Services has a booth outside this hall and looks forward to meeting and working with you. USAID provides a critical complement to the agencies of our government that focus more squarely on the supply side of environmental export promotion and finance.

I would like to close with a word about the current political climate. It is no secret that we who care about international development and the environment face an urgent challenge. We must work harder than ever before to convince the public that sustainable development assistance is in our national interest. We can make that case and I believe we will.

I believe the American people will recognize that today's security risks and tomorrow's economic opportunities turn on the success or failure of our efforts to increase development abroad and to open markets for American goods. I and my colleagues at USAID will spend the coming months making this case to the Congress and to the American people. I am sure that you are going to see a lot of heat. I hope that you will some light as well. I appreciate the opportunity to join with you here today. We at USAID look forward to working with you to shape and implement an aggressive National Environmental Technology Strategy. A sustainable future depends on it.

December 12 Luncheon Address by Dan Goldin
Administrator, National Space and Aeronautics Administration

Introductory Remarks by John Gibbons: I have come to know Dan Goldin in the course of my work in the Administration. I admire him as an engineer, an innovative thinker, an extraordinary administrator, and as a wonderful human being. His background includes a stint in NASA as a young engineer, and years at TRW where he literally built a large number of extraordinarily fine satellites. When you have an administrator who knows where the screws turn and how the sensors plug in, you have an administrator who is able to think and speak wisely and well about faster, better, cheaper. And that is the way he has been creating a revolution within NASA these past 23 short months. He has created an open process within NASA that engages the people in the organization's transformation. He has been the leading technologist as well as the leading innovator and manager. He has transformed the NASA workplace with great care and attention to diversity and equal opportunity in the organization's extraordinary staff. And that increased diversity is resulting in, I think, a stronger, more resilient and also much more interesting place for us to invest the taxpayers' money. It is with a great deal of pleasure that I welcome Dan Goldin as our speaker at this luncheon.

Dan Goldin: While thinking about the environment and sustained growth, the island of Madagascar, off the southeast coast of Africa, comes to mind. In the mid-1980s, some of our astronauts started taking pictures of Madagascar from the space shuttle. They saw some incredible things -- visually beautiful but also heartbreaking taking into account the implications of the pictures. When they looked down on Madagascar and saw the Betsy Boca River flowing out into the ocean, there was a huge red area at the mouth of that river. Here is where the sadness comes in. At the time of Christ, Madagascar had about 85 percent of its area covered by dense rain forests. Now, I understand, only some 15 percent of its mass surface is covered by these rain forests. What is happening is that, in order to survive, the people on Madagascar are cutting down the trees to provide heat, energy, and income. The faster they cut down the trees, the faster the erosion occurs, and the more the Betsy Boca River becomes clogged with sludge. And the more difficult it is to bring supplies up that river.

We could say, so what? This story is about the developing world. What does this have to do with modern society? What does it have to do with good business and the bottom line? Well, I think it was in the 1920s or 1930s when we developed freon. Freon was a wonderful material, a terrific material. You could put it on your hands and it was one of the least reactive materials we could find. And we were going to have the ultimate in safe fluids for air conditioning systems. We were going to have a better life through chemistry. But a funny thing happened. The freon evaporated into the upper atmosphere where it stayed for decades. We did not think about the feedback mechanism through which the ultraviolet radiation might interact with that freon and ice crystals, thus resulting in a tremendous problem relative to ozone. And now in 1994 we are still trying to understand the fundamental processes.

In both the freon and the Madagascar cases, we lacked an effective bio-feedback mechanism. The freon designers and users, like the people in Madagascar, were trying to the right things. But they became isolated from the environment. In our heavily urbanized society so many of us lose touch with the environment when we no longer see the leaves turning, thus indicating a change in seasons -- or not seeing the changes which one would experience by living on a farm. When you live on a farm, you can watch the patterns. You can watch how the animals live. You can watch how the crops grow. You have a closed-loop bio-feedback system in relation to the environment. It has become very clear to me that we have basically good people in America. We have people who want to do the right

thing, but we also have people who are fundamentally isolated from the environment. As technology moves forward, they become more technologically illiterate. Again, this happens not because they are bad but because of where our society is going.

Recall that the ancient Egyptians were so closely coupled to the cosmos that they knew when to plant. Every Egyptian knew that when the star Sirus appeared in the night sky just before dawn, the Nile was going to flood. Thus their lives were coupled with their environment.

Thousands of years ago the Polynesians set out in canoes to traverse the Pacific Ocean. They had a fundamental understanding of life. They could memorize the patterns of the stars in the sky and from that they could determine their navigation. They knew their location by observing when one star went over the horizon. They understood when they saw certain reflections on clouds where an island was located. They would look for birds because they knew the patterns of the migratory birds. If they could see birds, they knew where islands were by timing where the birds were. Thus the Polynesians were closely coupled to their environment.

Somehow we have become decoupled from our own environment. We have another problem as well. We are beginning to scientifically understand the basis of what is happening with the ozone layer, but there are many people who genuinely believe that there is no problem. So we have a basic mistrust because people do not understand. They are not closely coupled.

Let me give you some evidence of our technological illiteracy. I do not mean to demean the people that do it, but fast food restaurants rely on cash registers to determine how much change should be provided to customers because the young people do not know how to add and subtract. Now if young people educated in our schools cannot add and subtract, how are they going to understand the fundamental issues involving freon and the ozone layer? How can we expect them to be trusting? They basically mistrust the government because we have not given them the educational tools to understand what is going on.

Why do we have problems with bio-feedback? Why do we have problems understanding technology? Why do people think that technology is bad? We are decoupled. We are isolated from our environment and we have a fundamental lack of understanding of the technology that we so crucially depend upon.

Three to four years ago, I was working to sell spacecraft to Israel and other Middle Eastern countries. During a visit to the Negev Desert I was told that two or three thousand years ago, when the Romans were there, the Negev was a fertile area. And I was told that we still cannot figure out how they produced crops on less than an inch of rain per year -- how they trapped the water and used it for their crops.

In the Middle East I saw some rebuilt three-story houses built out of slabs of stone that had convective cooling. It was over a hundred degrees outside yet inside those rock houses it was in the low seventies. The people there understood convective cooling. But do Americans understand? To get convective cooling, we just turn on a fan. Do we technologically understand what we are doing when we undertake to make a room cooler? I know in my own bio-feedback I have to buy bottled water because I have a very sensitive stomach. If I drink tap water, I know my stomach hurts. I am angry that I have to buy bottled water because as a society we do not understand how crucial clean water is.

I discussed drinking water with the head of state of a Middle Eastern country. He said that it was like talking about going to Mars. He pointed out that America is building space stations. In contrast, the problem in his country is the lack of clean water to drink. He asked how could he think about going to another planet when the people in his country lack clean water to drink? This problem in that country represents a tremendous opportunity for U.S. business. American industry could help people, improve the quality of their lives, and create jobs and opportunity.

All of us need to overcome the mistrust, fear, and lack of technological understanding of our environmental situation. Today I saw an item in the *Washington Post* noting an improvement in NASA's capability to measure the degree of thermal expansion of the ocean's surface. Besides continuing to increase such technological capabilities, we also need to improve our collaboration with international partners in measuring the surface of the ocean. Such collaboration can help us reduce mistrust. If we all make the same measurements, if we all have the same database, and if we all analyze the data together, I do not think the mistrust is going to exist. After we disseminate the data, we can make some decisions. I view NASA's job as data collection, data analysis, and education so the policymakers can make some very big decisions.

Another very important issue is the Supersonic Transport. If I talk about the Supersonic Transport to environmentalists, they may be technologically illiterate on the subject. Their immediate reaction is don't you dare build it. But technology is not bad. It is how people utilize technology that could be the problem. The Europeans built the first SST. It was an unbelievable technological success. However, it did not deal with the feedback problem, e.g., concerning damage to the atmosphere, loudness during take-off and landing, and cost effectiveness. Now that we in the United States are rethinking the Supersonic Transport we are taking a different approach. We are starting by asking, "What is the objective"? The objective is for America to win a quarter of a trillion dollars worth of business, generate 150,000 jobs right at the cutting edge of technology, and develop technologies that will propel us well into the next century. But when we do it, let us utilize technology so that we do not damage the atmosphere, so that the planes take off without breaking eardrums on the ground, and that it be so economical that there is not a premium price that you have to pay so it's open to all people in the world to get on these planes. Then Boeing and McDonnell-Douglas could sell them like hot cakes. Let us help them get very rich. This is a win-win opportunity. We help society, we generate jobs, we get technology, we move to the next step.

By the way, in order to get an engine that does not damage the ozone layer, you have to get low oxides and nitrogen. To do that requires you to get the combustion process up by a factor of two. Thus econo-efficiency doubles. The fuel efficiency doubles. It is a wonderful world. And we cannot use metals of old. We have to use ceramics. The U.S. aircraft industry is on the cutting edge in developing ceramic combustion systems. Perhaps we could take those ceramic combustion systems and help Detroit build cars with double econo-efficiency, with half the fuel consumption, and with cars that would sell well all over the globe.

Let me talk about another application. We at NASA over the next two decades are committed to understanding what is the relationship between our atmosphere and our environment and the planet earth. We are using a dynamic three-dimensional model. Instead of having emotional discussions about whether or not there is a greenhouse effect, we would like to work scientifically with countries around the world to carefully examine what is going on. If we share our data beforehand, heads of state when they get together can avoid acting on emotion and rumor. Instead they will have hard, peer-reviewed scientific data on which to base decisions that will affect almost every person on this planet. To further our data collection we are going to launch over the next few decades a minimum of 33 spacecraft. We will be able to generate a tremendous storehouse of scientific knowledge.

Although we are not going to pick winners and losers, NASA is working with U.S. firms that seek to sell remote sensing services. We will find ways to use NASA's database, information systems, computers and analytical tools to help companies develop commercial products. There already is a remote sensing market totaling about $800 million a year. It could double or triple. The heart of this business is not the spacecraft. Rather, it is going to be in the commercial services to be provided on a worldwide basis.

I feel confident that America will become prominent in this market, despite the considerable foreign competition. We can do so many things. For example, we are employing remote and visible observation to study the interaction of the earth's environment with the planet. American companies will be able to take products to market so farmers could have a lower cost of business, thus making U.S. farming more competitive.

So this is what NASA is all about. We are about education, inspiration and hope. I am very, very excited about this conference. I want to congratulate Jack Gibbons for bringing everybody together. Let us all work hard to eliminate environmental isolationism and technical illiteracy -- and work to advance the generation that will be prosperous and rich and have a better life than we have had.

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December 12 Dinner Address by Carol Browner
Administrator of the U.S. Environmental Protection Agency

Introductory Remarks by John Gibbons: Administrator Browner's responsibilities at the U.S. Environmental Protection Agency (EPA) include safeguarding our nation's air and water resources, overseeing solid and hazardous waste disposal and management, cleaning up Superfund sites, and setting rules for pesticide use and food safety.

Carol Browner is committed to achieving environmental goals, and she stresses common sense, innovation and flexibility in reaching for those goals.

She grew up in Florida on the edge of the Everglades and I think that has influenced her career path through the years. She took her law degree at the University of Florida, worked for public interest groups and the Florida legislature, worked on Capitol Hill, and served in 1991-1993 as Secretary of the Department of Environmental Regulation for the state of Florida. In that position, she focused on wetlands protection, hazardous waste disposal, and Everglades clean-up.

As President Clinton's EPA Administrator, Carol Browner has made pollution prevention one of her top priorities. Environmental technology, of course, can play a central role in advancing pollution prevention.

Through the interagency Environmental Technology Initiative (ETI), which EPA chairs, Carol has helped lead government efforts to advance environmental technologies. Carol also has worked hard on the Global Climate Change Action Plan and in negotiating the environmental side agreement to the NAFTA agreement. So you can see here we have a person with extraordinarily fine-tuned capabilities. So we are very pleased, Carol, that you are able to be with us this evening.

Carol Browner: I want to begin by congratulating you, Jack Gibbons, and all of your colleagues at the White House for making this such a successful event. That there are over a thousand persons attending this conference is a real testament to the very hard and successful work of yourself and Mark Schaefer. I hope that this will not be merely the first such conference, but will be part of a series of such efforts to reach out to all of those in the country who are interested in and committed to developing new environmental technologies.

It is also a pleasure to be here this evening with Richard Riley, the Secretary of Education. He has been kind enough to bring with him a group of children from South Carolina who will be able to perform for all of us later.

One of the great things about kids today is that they know almost everything about the environment, and that which they do not know they are very, very eager to learn. And I would not be surprised if in this group of schoolchildren we have some future environmental leaders.

Each and every one of you here this evening is a leader in the field of environmental technology. And as such, you are making a vital contribution to the health of our communities, the health of our economy and our children's future.

There are those across the country who say we cannot clean up our air, water, and land -- and develop our economy. There are those who say that pollution is the price of progress. Bill Clinton and Al Gore do not agree with those people. I do not agree with those people.

All of you here tonight are proof that environmental protection actually helps our economy, that a healthy environment and a healthy economy are inextricably linked.

The Clinton-Gore Administration is committed to promoting our environmental technology industry because it is a common sense, cost-effective way to protect the health of the people of this country and the health of our natural resources.

I returned on Saturday from the Summit of the Americas and our President was very successful in securing agreements that will benefit all the people of the Americas. Leaders from throughout the hemisphere came together to talk about how best to open up trade among our nations. Part of opening up trade was a parallel effort to promote environmental protection and create opportunities for environmental businesses, for environmental technologies.

President Clinton said at the Summit that our prosperity will be short-lived if we do not protect our resources and our environment. I want to share with you this evening what the Administration is doing to change how we seek to protect our environment and support environmental technology -- what we are doing to help promote innovation, ingenuity and creativity, all which served to make this such a great country.

The first thing that we have done at EPA is to launch the new Common Sense Initiative (CSI). Quite simply, this is a fundamentally different system of environmental protection. It replaces the pollutant-by-pollutant, crisis-by-crisis approach of the past with an industry-by-industry approach for the future.

In six different industries representing more than 20 percent of the GNP, we have brought together under the CSI effort industry leaders, environmental leaders, and state and local government representatives. And we have called on all parties to set aside their historical differences.

Take off your adversarial hats and work together to figure out how this industry can best achieve environmental protection. How can this industry best prevent pollution? What makes sense for an oil refinery may not be what makes sense for the printing industry or an electronics firm.

If you look at the history of environmental regulation in this country we have frequently not only told industries the standard that they must meet, but we have also dictated the means by which they must meet that standard. We have prescribed the technology they must use.

So, rather than creating competition and fostering creativity, we have stifled and we have limited the number of environmental solutions to any individual problem. Why not move beyond the one-size-fits-all regulations of the past and help industry to not just meet the standards but to actually exceed the standards?

Our second effort is the President's Environmental Technology Initiative (ETI) which is advancing innovative environmental technology and increasing exports of U.S. environmental technologies abroad. We are taking the most serious environmental problems and matching those problems with the people who have the very best solutions -- the people in this room.

We are changing our regulatory framework to promote innovation. We are investing directly in the most promising breakthrough technologies. We are helping buyers find the technology that is right for them. The result is that we are putting the very best ideas into use and not just here in the United States, but also overseas.

Number three, I want to announce a package of reforms that we will be undertaking at EPA that we believe will tear down barriers to innovative technology.

I want to share with you the story of a man named Allen Staples. This is a man I met in North Carolina. He is the owner of a biotechnology firm. He designs testing kits for detecting hazardous chemicals in soil and water samples. He told us that his kits could do in minutes the job that had previously taken days and that the cost per sample would be $35 instead of $50 or, in some instances, $500. He also told me about coming up with an innovative product and trying to get it approved by EPA. He said that sometimes the process can take as long as six years, and that for a small company that is simply too long.

Well, we listened to Mr. Staples and we listened to others who had a similar problem. Tonight I am happy to announce that we have reinvented the EPA approval process to get environmental monitoring methods to the market faster. We will now be able to give these small companies and others the approval they need in eighteen months or less. Thus, we are changing from six years to eighteen months or less. As for Mr. Staples, his test kit is the first of its kind to be approved under the new process.

I am also announcing that I am charging our Environmental Monitoring Management Council to radically overhaul our monitoring requirements.

We must standardize our monitoring methods so you do not have to obtain three separate approvals to prove, to demonstrate, that your product works to measure pollution in air, water and soil. Right now EPA requires a separate one for air, another one for water, another one for soil. We are going to change that. At the same time, we have placed technology advocates in every one of our major program offices. These are people who are responsible for working with environmental technology firms, developers and consumers providing assistance, getting them the answers they need.

Finally, I am announcing a new verification program to have EPA verify that new products do what their inventors say they do so that we can get good products out to the marketplace and accepted by the consumers as quickly as possible.

We believe that this change will complement the Administration's Rapid Commercialization Initiative (RCI) that was announced earlier today. So we are taking some very important, bold steps to help the environmental technology industries of this country grow and compete in the expanding world market.

If there is one thing I would like to say to you in conclusion, it is that change is the genius of America. Throughout world history, empires, kingdoms, and nations have collapsed because they have failed to change. Our nation is built on a very proud tradition of change. We in this Administration are committed to changing our approach to environmental protection so that we can do the very best to protect the public's health, to protect our air, our water, and our land in a cost-effective, common sense manner.

You are a part of the genius of this nation and we thank you for what you do in finding new solutions to these problems. It would not be possible for me to do my job as the head of this country's environmental agency without you. We look forward to continuing to work with each and every one of you so that we can give to our children a safe and prosperous world.

December 13 Luncheon Address by Senator Joseph Leiberman

Introductory Remarks by John Gibbons: Up to now in this White House Conference we have heard from a variety of stakeholders in the environmental equation: the Administration, industry, local government, state government, universities, non-governmental organizations -- a long and distinguished list. But absent, thus far, has been a very important stakeholder, namely the United States Congress. And I am sure you understand that that is because we have saved the best for last. I am going to fill that gap now by talking about a person, a truly remarkable member of the United States Senate, a person who is uniquely qualified to speak on and about the issues that we have been wrestling with. This person is Senator Joe Leiberman. He was elected to the Senate from the state of Connecticut in 1988. He previously served in the Connecticut legislature and also as Connecticut's Attorney General. It also is interesting to note that one of the volunteers in an early campaign of Joe Leiberman's was a young fellow named Bill Clinton. I cannot think of any member of Congress better equipped by position, disposition, record or commitment to advance the cause of environmental innovation and sustainability than Joe Leiberman. In the Senate, he is a member of the Committee on Environment and Public Works, where he has been chairing the Subcommittee on Clean Air and Nuclear Regulation; of the Committee on Armed Services, overseeing the very important role for the Department of Defense in the area of environmental security and federal facilities; the Committee on Small Business, where he has chaired the Subcommittee on Competitiveness, Capital Formation and Economic Opportunity; and, finally, the Committee on Government Affairs, where he has chaired the Subcommittee on Regulation and Government Information. So, the Senator has an extraordinary vantage point with regard to key elements of the environmental technology challenge. Business issues, environmental standards, federal facilities, environmental security, government regulation, you name it. The Senator has been described as having the best environmental voting record of any member of the U.S. Senate. He and his staff have been tireless champions in support of high technology investments and innovation as a source of economic growth. He was a driving force behind the Senate passage of the environmental technologies legislation this past year. And in a very real sense, Joe Leiberman embodies the duality of this issue. He combines an absolute zeal for economic progress with an unmatched sense of stewardship for our environment and care for the future. But I guess the best accolade I could cite for Senator Leiberman is the fact that the voters of the state of Connecticut said it best when they reelected him with greatest vote total in the state's history.

Joseph Leiberman: I appreciate what you, Jack Gibbons, and your staff have done to put this conference together. I want to express my thanks. We miss Jack on Capitol Hill [where he served as Director of the congressional Office of Technology Assessment]. But the Administration and the nation have gained greatly. I really do want to thank him for the extraordinary service and leadership he has given.

I am very impressed by the turnout here at this luncheon, and at the entire conference. I am pleased to find myself among so many who are anxious to bring together the matters of environment and economy and to show that they are not inconsistent and not inherently in conflict. I would like to talk about market mechanisms. I think the market has spoken in this conference, and the fact that over a thousand are here is an expression of a very powerful message.

This message is that a strong and innovative environmental technology industry is critical both to the nation's economic future and to our environmental future. At a time when American producers are desperately searching for any edge they can find to compete in the global marketplace we know that

new environmental technologies can increase our efficiency, cut our costs, and expand exports. We also know that by reducing costs all around, we can move much closer to ensuring a healthier and more beautiful environment for our citizens. And, of course, we all hope that our progress here will make the rest of the world, if you will allow me to put it this way, green with envy. And ultimately lead to a cleaner, safer global marketplace.

With these ideals in mind, I particularly want to also congratulate Vice President Gore and all those in the Administration who brought forth the initiatives that were announced here yesterday. These plans are going to help break down the barriers to development and use of new environmental technologies and, thereby, I think they will reduce the cost of compliance for American business with regard to environmental regulations. They will also reduce the cost of compliance for our state and local governmental partners.

For the last two years, as part of a very strong bipartisan effort to support the public-private partnership here, I was proud to work on some of these initiatives with the Administration and with Senators Baucus, Chafee, and Mikulski, and Congressman George Brown. So, I am particularly proud to have been invited to participate in this forum today and to share a few thoughts with you. I know that there may be some feeling of trepidation out there these days regarding the fate of the environmental movement, particularly in the new Congress. I think that is something that we have to address. The post-election conventional wisdom says that there is little hope for progress in the new political climate, that green legislation is doomed from the start. The reality, of course, is much more complex than that, and I want to suggest, ultimately more optimistic than that.

On the one hand, the electorate is widely and clearly dissatisfied with government. As a survivor of the elections of 1994, I can tell you that the people out there want less of the big bureaucracy and the costly intervention from Washington. That probably includes some of the traditional command and control environmental legislation. I think they want new solutions that rely more on the marketplace. But on the other hand, it is clear that once you get outside the Washington Beltway, the public's commitment to protecting the environment, the people's interest in a clean and a safe environment, is undiminished. In my own travels through Connecticut I have found extraordinarily widespread support, cutting across all political and demographic dividers, for laws to protect our health and safety and conserve our environmental natural resources. To back up my anecdotal experiences, there was a poll of voters completed shortly after the November election which showed that 83 percent of the people polled nationally, considered themselves, and are proud to consider themselves, as environmentalists. Fifty-eight percent said that they did not hear enough about environmental issues from the candidates.

What these seemingly conflicting messages -- i.e., the yearning for a smaller, less intrusive government and the support for a strong environmental policy -- tell me, is that we have got to be smarter in our approach to environmental protection. Particularly if we want to sustain that public support. We need to harness the marketplace to work for environmental protection using innovative programs like the acid rain provisions of the Clean Air Act and the industry-government Global Climate Change partnerships such as those announced by Energy Secretary O'Leary yesterday. What we have got to do in the years ahead, like the rest of American society, is to get leaner and tougher about environmental protection. We have to concentrate our attention where the risk to our health and the environment is greatest. And we have to assure industry and the public that our laws are based on sound science. Achieving those goals is not going to be easy. But, frankly, if we do not achieve those goals, we are not going to move forward in environmental protection.

I know that the U.S. Environmental Protection Agency (EPA) will have serious trouble developing regulations that are based on credible science if its resources are depleted. And I want to suggest to those of you here from the private sector that EPA needs your help in fighting for the resources it needs to do its job better. In evaluating risks, we need to understand the limitations of our own knowledge. I am thinking, for example, of the recent studies of the effects of toxins on reproductive and developmental abnormalities. Your work is essential in overcoming these hurdles.

On the most basic level the development of innovative environmental technology will enable us to maintain strong environmental protection at a dramatically lower cost. That is the great hope that I see for environmental protection in the environmental technology movement. Involving federal and state partners such as EPA in this effort is important because these agencies obviously have a sense of what the regulations are that will be promulgated, not tomorrow, but over the next decade. So working in partnership with the federal government is the best way to focus technology development on areas where the economic and environmental benefits will be the greatest. Involvement in technology development will also help increase awareness by EPA and other regulatory agencies of what is or is not possible from a technology standpoint as they develop their own regulations. So this is a partnership that has to involve two-way dialogue.

Advances in environmental technologies are critical in meeting both our short-term and long-term environmental goals. As you all know, we have an immediate need for better clean-up technologies. Unfortunately, today we simply do not have the technical know-how to clean up some basic types of contamination which the public wants us to clean up, e.g., soils contaminated with heavy metals or ground water polluted with oily wastes. The federal government and private industry face the prospect of spending billions and billions of dollars of public and private funds on these environmental clean-ups.

Indeed, part of the on-going outcry against the Superfund program results from the lack of cost-effective technologies or, in some cases, the lack of any technology that is suitable at all. As a result, during the reauthorization process in the last Congress, we included detailed provisions allowing companies to obtain waivers from the standards or allowing them to meet less protective standards when there was proof that there was currently existing no effective clean-up technology. In other words, our clean-up strategy had to confront the reality of the state of the technical world.

Over the long-term, improvements in environmental technology, particularly when it comes to pollution prevention, are going to be critical to the ability of American companies to compete. Not only do new technologies reduce compliance costs, they improve competitiveness because they lead to greater efficiency. I remember one executive of a large U.S. computer company testifying at a hearing that I held a couple of years ago. He said that in his highly competitive industry the production of waste by-products is now seen as a sign of production inefficiency. And it is not only a desire to be good citizens and comply with the environmental laws but a desire to maintain a competitive edge by eliminating waste that motivates this company's many hundred million dollar investment in environmental technology and clean-up.

I am proud to say that the Administration's on-going efforts are specifically designed to focus on providing incentives for the development of new technologies that will help smaller businesses meet the requirements of current regulations and even those that will be coming into existence over the next decade or two. For example, EPA is now involved in a very constructive partnership with the dry-cleaning industry to develop technologies that provide alternatives to the use of toxic chemicals. I hope that one day these pollution prevention developments will eliminate the need for expensive pollution controls. Not only will these new technologies lower costs to American industry, but in line

with our great hope and confidence, they also will increase American exports and create jobs here at home. The new technologies will respond to the most fundamental source of the public anxiety that has been so much commented on both before and after the election. This is the concern about job security and the need to re-employ those who have lost their jobs in the structural changes that have occurred in our economy.

Probably you have heard one estimate that worldwide demand for environmental goods and services may reach three hundred billion dollars a year by the year 2000. Although the congressional Office of Technology Assessment has found that American companies remain competitive in most environmental technologies sectors, it has also found that the American position has eroded in some areas such as air, water and waste technologies. This Administration's construction of a coherent interagency policy to encourage the development and export of environmental technologies will help ensure that American companies can maintain our worldwide competitive edge and not slip in response to the obvious surging interest of other developed economies in meeting the worldwide demand for environmental technologies.

Now let me focus for a moment on one of the most important parts of the Administration's new initiative, the verification and testing program. I think this is so critical to achieving the goals that have brought so many of you here to this conference. One criticism that I frequently hear is that EPA's process for issuing regulations freezes technology development when it is based on a so-called reference technology. The regulated community is reluctant to deviate from this referenced technology and that reluctance deters technology innovators.

Yesterday's announcement by the Vice President of the new program to verify the cost and performance of new technologies relative to the requirements of federal regulations will, I think, greatly reduce the regulatory barriers to the development of the desired new technologies. In fact, my friend Julie Balaga from Connecticut, who was the EPA regional administrator for New England under President Bush, told me a while back that creation of a verification process was, in her opinion, the single most important step we could take to encourage technology development and more cost-effective compliance strategies. So I am particularly pleased that this program was announced and it will involve the state and local government as partners. The program can save them a lot of money as well as everyone else.

The testing program should also be a big help. Currently, regulatory and liability concerns can strain the ability of too many technology developers to test their products or processes in real situations. Not surprisingly, and I hear these stories often as I talk to people in this business, users are unreceptive to technologies that are not well tested -- thus creating a very burdensome Catch 22. The Administration's initiative announced yesterday will go far to help solve that problem.

It is not going to be easy to realize all those benefits, however, if we allow the partnerships that we have forged over the years, particularly between the federal government and high technology private industry, to disintegrate. As I look forward to the next Congress, what I am particularly concerned about is that the new majority in Congress will seek to cut back or perhaps even eliminate some of the basic programs in our federal government that support public-private partnerships that spur technology development. For example, I am thinking of the Department of Defense's Advanced Research Projects Agency, the Advanced Technology Program, and the range of initiatives that come out of the National Institute for Standards and Technology.

I assure you that my fears here are not partisan and not hypothetical. Environmental technology programs have been specifically targeted for elimination by the incoming Chairman of the House

Science and Technology Committee. While I presume I am arguing or preaching among a congregation of believers, I want to make the point that these programs are not about the dreaded "industrial policy." They are not about central government planning. And they are, most assuredly, not about bail-outs of failing old smokestack industries.

They are about government working as a supportive partner with industry, as government has done so often in the past, supporting research and development efforts. This traditional government role has focused on nurturing in the early stages some of the industries and sectors of our economy that have become the strongest, such as agriculture and aerospace. The aim has been keeping America dominant and, at least, strong in those sectors and maintaining a critical core of jobs in those sectors. Both American business and the public clearly have benefited from such partnerships and will continue to if we can sustain them. For example, clean-up costs for federal sites, which are obviously paid for by the taxpayer, will be greatly reduced with the proper development of environmental technologies to do that clean-up. And jobs will be created to do it and, of course, the environment will be healthier and less spoiled.

The threatened manufacturing technologies support programs are not radical and, as I have said, they are not partisan. The Bush Administration never had any doubt about whether or not the government should play a role in R&D. The final budget submitted by President Bush said, "The federal government has a long history of funding research and development with the goal of spurring innovation. It is widely acknowledged that research and development investments lead to new knowledge and innovation which, in turn, leads to economic growth. There is also strong analytical evidence that research and development is an important contributor to productivity growth." There are also related programs that have been developed in recent years such as the Commerce Department's manufacturing technology centers which have proved critically helpful, particularly to small businesses, in modernizing manufacturing equipment and in adopting manufacturing practices that boost product quality and profits. I hope in the years ahead that these technologies centers will expand in number and will also begin to advise smaller businesses about how to use new environmental technologies to meet the requirements of law.

To protect these valuable and historic governmental initiatives in the technology field, not to mention to protect the very important breakthrough plans announced yesterday by the Vice President, we are going to need your help. We need everyone here today to work with us to explain the importance of these programs to our colleagues in Congress and to help make certain that these programs are not expunged but are, in fact, expanded. I am confident that this is a battle we can win. I am even more certain that it is a battle we must win to guarantee a brighter future for both our environment and our economy.

In the meantime, I want to congratulate all of you for the hard work that you have done to bring us to this point and I congratulate those in the private sector, of course, in particular, as well as those in the public sector. As I look out across this room, it seems to me that you exemplify the ingenuity and the entrepreneurship that have driven our economy throughout its history and that is the ultimate source of the better life that our people have lived. As the American people worry about whether the next generation will live as well as this one has, it seems to me that the entrepreneurship that you represent holds within itself the critical hope that they will in fact live better lives. This initiative is about harnessing that creativity to enhance America's competitive standing in the world economy and to reduce the need for some of the governmental bureaucracy that exists today. As such, it is not only an expression of the Vice President's interest in a healthier environment and a stronger economy, it is also an expression of his commitment to a leaner government.

I came here and I leave here heartened by your presence and optimistic about what we are going to be able to do in the future. I thank you for taking the time and spending the money to be here. I wish you good luck and God's speed in the years of opportunity that are ahead for all of us. Our future is in some substantial degree in your hands. Good luck and God bless you.

SECTION B

BREAKOUT SESSION

SUMMARIES

Breakout Session 1
Environmental Technology Export

Co-Chairs: **Ann Alonzo, Deputy Assistant Secretary for Environmental Technology Exports, Department of Commerce (DOC)**
Howard Schirmer, Jr., President, CH2M Hill International, Ltd.

Panelists: **Lewis P. Reade, U.S.-Asia Environmental Partnership (US-AEP)**
Joan Gardner, President, Applied Geographics, Inc.
Jessie Harris, Deputy Assistant Secretary for Science and Technology Policy, Department of Energy (DOE)
Julie Belaga, Director, U.S. Export-Import Bank (Ex-Im Bank)
John Savage, Vice President, Bank of America
Bosworth Dewey, Overseas Private Investment Corporation (OPIC)
Ann McKinney, Director of Trade Programs, U.S. Export Council for Energy (ECRE)
Fred Eberhart, Regional Director for Asia, Trade Development Agency (TDA)

Breakout Background

The world market for environmental technologies is expected to reach $600 billion per year by the year 2000. To enhance U.S. environmental technology exports, President Clinton, in his 1993 Earth Day speech, directed key federal agencies to assess the domestic and international competitiveness of the U.S. industry and to formulate a strategy that would give U.S. companies the assistance they need to increase exports and create U.S. jobs. An interagency team, led by the Department of Commerce, developed a strategic framework which was announced in the November 1993 report, *Environmental Technologies Exports: Strategic Framework for U.S. Leadership*. The report assigned responsibility for further development and implementation of the Administration's environmental technologies export strategy to the Environmental Trade Working Group of the interagency Trade Promotion Coordinating Committee (TPCC). The TPCC was created by the Export Enhancement Act of 1992 and provides the statutory mandate under Section 204 for promoting exports of U.S. environmental technologies.

The breakout session was divided into two panel discussions, focusing on international markets and financing. Special emphasis was placed on obtaining private sector ideas and suggestions on ways to enhance federal export promotion programs, initiatives, and services, and on how to penetrate the big emerging overseas markets.

Summary of Key Issues and Suggested Actions

International Markets: Role of the Federal Government

- Target specific regions to streamline and optimize the use of federal resources in a focused manner, while supporting U.S. exports globally. Export promotion should focus on demand driven needs of developing countries for environmental technologies.

- Appoint in-country representatives and local staffs to gather up-to-date and accurate market information, and provide in-country support for U.S. firms.

- Foster in-country relationships to obtain valuable information about the local cultural, legal and business nuances.

- Work with private industry to disseminate appropriate foreign market, federal program, and export success story information in the most effective manner possible as a means to stimulate greater industry participation in foreign markets.

- Promote U.S. technology in foreign markets through trade missions and international demonstration projects.

- Educate foreign public and private sector representatives about the benefits of applying U.S. technology solutions to specific environmental needs.

- Work with developing nations' governments to help harmonize environmental standards, develop flexible regulatory structures, and encourage the evolution of national environmental policies to industrialized standards.

- Foster greater collaboration between TPCC members and the private sector to forge successful joint ventures in establishing a concrete U.S. presence in targeted export markets.

- Create multifaceted relationships between government, industry, academia, and research institutions to address specific developing market needs.

- Continue to develop channels to obtain private sector feedback regarding the steps being taken by the TPCC's export promotion strategy.

International Markets: Private Sector Views

- Focus federal resources to better assist companies to export technology by disseminating market, business, and federal program information through the environmental industry and other effective media.

- Clarify the environmental technology industry definition to include clean and pollution avoidance technologies in firms that do not fall under the typical definition, such as steel manufacturers.

- Adopt within the U.S. environmental technology industry a different set of expectations about the amount of time, money, and risk involved in exporting. Selling abroad is a strategic company decision that requires patience and commitment.

- Take the time within the U.S. environmental technology industry to assess and understand foreign customer leads, and to develop consistent representation and business relationships.

- Determine how to focus government support through regions, industries, and customer needs.

- Involve the environmental media in trade promotion activities.

Finance: Role of the Federal Government

- Cooperate through the TPCC with multilateral financial institutions and with the private sector to maximize the use of public and private funds for export promotion and assistance to companies in the project pipeline.

- Recommend that the private sector develop export finance strategies that include direct foreign investment, and establish partnerships with financial institutions to create sound financial packages.

- Identify and track major projects and offer timely advocacy support, matching tied aid or grants to foreign public and private sector entities to ensure that U.S. firms win bids on foreign procurements.

- Create a seamless support structure to assist industry. The role of government is to form teams or consortia of industry, government, and non-governmental organizations to help private industry compete against large foreign competitors. This issue raises the need to reexamine U.S. antitrust law.

- Encourage and assist smaller firms to partner with other small to medium firms through consortia or with larger and more experienced partners to gain a foothold and eventually establish a presence in foreign markets. A recent Raytheon win over a French competitor for a $1 billion SIVAM project in Brazil is a model for how business should be conducted by public-private partnerships on a government-wide scale.

Finance: Private Sector Views

- Have the federal government provide business development finance to U.S. firms that are losing to foreign competition whose governments subsidize business development. Such support, presently lacking, would complement federal programs that involve financing feasibility studies through the Trade Development Agency (TDA), financing exports through the Export-Import Bank (Ex-Im Bank); and financing direct investment through the Overseas Private Investment Corporation (OPIC).

- Urge the federal government to consider allowing OPIC to operate in Mexico and China, TDA to operate in Brazil and China and U.S.-Asia Environmental Partnership (US-AEP) to operate in China; and, allow the Ex-Im Bank to finance public sector projects in Brazil.

Presentations on International Markets

Session Co-Chair **Ann Alonzo**, Deputy Assistant Secretary, U.S. Department of Commerce (DOC), provided an overview of the potential export opportunities for U.S. firms in the international environmental market. The global environmental market is currently estimated at $200–300 billion and expected to double by the year 2000. Whereas Europe and Asia export 21 to 30 percent of their domestic technological products, the United States exports only five percent despite U.S. industry's more advanced technology and greater expertise.

The TPCC, a 19-member interagency body, is responsible for streamlining U.S. Government export promotion efforts and implementing the National Export Strategy. This strategy has specific goals and action items designed to increase exports of U.S. environmental technologies. The TPCC's Environmental Trade Working Group and its seven cluster groups have the responsibility for executing action items under the strategy such as public-private partnerships, technology development, overseas demonstrations, regional strategies, training, export finance, and framework management. To date, the TPCC has developed marketing plans and regional strategies for special markets such as Mexico, Argentina, Chile, Poland, the Czech Republic, South Korea, and the Chinese Economic Area (China, Hong Kong, Taiwan), which offer strong opportunities for U.S. firms that want to export. These markets were chosen by considering the following factors: where U.S. companies want to go; the state of regulatory structure development; political and economic stability; and potential for technology transfer.

Alonzo emphasized the importance of partnerships, either government to government, agency to agency, or government to industry, as a means to build the kind of rapport, liaison, and communication necessary to facilitate environmental technology export. The Environmental Technology Advisory Committee (ETAC) and the Environmental Partnership Cooperative Program are excellent examples of government and private sector associations which focus on export issues, industry needs, and leveraging resources to support export promotion.

The Summit of the Americas Conference held in Miami in December 1994 presented prime opportunities for enhanced federal government and industry cooperation to achieve greater export expansion in Latin America. Consensus was attained by the conferees that a free trade zone would be established by the year 2005; "green" agreements will be instituted to focus on habitat protection, pesticides, lead phase out, and pollution avoidance; and a 1996 summit will be held in Bolivia to develop a framework for greater environmental protection and cooperation. It is estimated that the market to implement these initiatives and purchase environmental goods and services in Latin America will be $12 billion by 1997. The federal government already is taking initiatives to support greater U.S. involvement in environmental exports to Latin America. For example: five Inter-American Development Bank loans are available for sanitation and environmental projects in Chile; U.S. funding is available for water and wastewater treatment projects in Argentina; a recent matchmaking mission to Brazil involving 19 U.S. companies resulted in the award of a substantial contract; and, a major trade mission to Latin America is scheduled for August 1995.

Session Co-Chair **Howard A. Schirmer,** CH2M Hill International, provided an industry perspective on the global environmental market. It is clear that there is a substantial market. Estimates range from $250 to $270 billion with a 10 percent growth over the next 10 years. There is keen competition. Creative partnering is the best solution to achieving competitive advantage. According to Schirmer, the ideal is to move target countries (developing and newly industrialized) to the later stages of environmental development where the United States is most competitive. For CH2M Hill, the priority targets are Asia, Latin America (especially Mexico, Argentina, Chile, and Venezuela), Central and Eastern Europe, the Former Soviet Union, Egypt, Saudi Arabia, Israel, and the West Bank. CH2M Hill's strategy for attaining market share in these countries includes teaming with federal agencies (e.g., the U.S. EPA), academia and non-government organizations; working closely with indigenous staff; and capitalizing on assistance provided by U.S. embassies. In CH2M Hill's view, the most effective federal support programs have been those which level the playing field for award for international contracts, the TDA which assists in developing international markets, and the U.S. Environmental Training Institute which trains foreign nationals on U.S. regulations. Schirmer

recommended lifting the ban on trade in China, lifting the travel ban in Lebanon, allowing the TDA to work in Brazil, and providing greater financing for infrastructure projects in Israel.

Lewis Reade, US-AEP, noted that his organization provides assistance in technology development, including in finance and management. It brings the resources of 25 governments and agencies to bear on four areas of focus: industrial pollution prevention/control, urban environmental infrastructure, professional networking, and training. The goal is to merge its resources with those of U.S. companies to make transactions happen. Currently, US-AEP awards grants to conduct overseas demonstrations, provides representation at the Asian Development Bank (ADB), places Technical Cooperation Officers throughout Asia (the newest in Sri Lanka and in China by the end of 1995) to assist U.S. companies, and funds pollution prevention and waste minimization projects.

Reade discussed the vast market in Asia for environmental goods and services. It is estimated that the Asian market is $80 billion per year and 85 percent of the technology to be applied will be new. Japan represents the largest portion of the market but growth is occurring in South Korea ($5 billion over the next 5 years), Taiwan ($6 billion, mostly industrial clean-up and infrastructure), and Hong Kong ($2.6 billion, involving sewage treatment, chemical waste disposal, hazardous waste management, and end of pipe solutions). China is the largest producer of environmental degradation in Asia. If it can stabilize the tension between its central government and local authorities, China may be, in the near future, a substantial purchaser of large amounts of products and services to treat air and water pollution and to attain clean coal, pollution avoidance, and waste minimization solutions.

Joan Gardner, Applied Geographics, Inc. (AGI), presented a case study on doing business with Mexico. AGI was part of a Mexican-British joint venture, called AquaMex GIS, to conduct infrastructure mapping. A small U.S. firm seeking to go international should work closely with the Environmental Export Council or other trade associations to gain insight into the market climate and potential sources of export assistance funding; establish local contacts in the host country; use U.S. embassy advocacy to obtain credibility and host country recognition; allow time to establish working relationships with potential buyers; and maintain those relationships for long-term advantage. The U.S. firm needs to remain flexible and recognize that there are many cultural, language, and economic differences in doing business internationally. Indigenous contacts are the best resources to help a company deal with local impediments. Gardner noted that there are Mexican programs to develop environmental laws and regulations, to staff its infrastructure, and to develop scopes of work. Winning an international contract in Mexico is very difficult. To export to Mexico, a small U.S. firm needs to partner with a larger U.S. firm. This partnership should align itself with a Mexican entity to successfully bid and win a Mexican contract.

Jessie Harris, Deputy Assistant Secretary for Science and Technology Policy, DOE, described the DOE's involvement with TPCC in developing reports on the Czech Republic's and Poland's environmental markets. The Polish and Czech environmental efforts both involve developing a national policy on the environment and trying to ascertain the considerable extent of their environmental contamination. The market for environmental goods and services in the Czech Republic is estimated to be between $50 and $100 billion and Poland to be almost $200 billion. The Czech Republic is the most economically advanced and stable of the two countries and needs technologies and services in energy efficiency, air pollution control, and waste management. Poland needs assistance with developing clean coal technologies.

The United States presently holds the largest share of the market in the Czech Republic and the second largest in Poland. But, it faces strong competition from Germany and other members of the

European Union. To beat the competition and increase the U.S. market share, Harris suggests that the U.S. Government help U.S. companies to put together comprehensive export packages including support services, financing options, in country presence, etc. At present, DOE is providing assistance to U.S. companies on low emission and flue gas desulfurization projects, participating in public-private partnerships and coordinating a TPCC overseas demonstration project in Poland. DOE, EPA, and the Czech government are developing an environmental management plan in Silesia, conducting a coke oven risk assessment, designing air pollution early warning systems, and opening an environmental information center. DOE is currently planning a regional conference in Bucharest, Romania, to exchange information on environmental technology, the regional market, and trade.

Harris explained that to serve industry more effectively, the U.S. Government needs information on: (a) What is U.S. industry's view of federal participation in foreign market development? (b) Is TPCC information helpful? (c) How should the U.S. Government focus on export promotion? (d) Is it responsive to industry needs? (e) What are the export barriers industry is facing?

Discussion on International Markets

Initial discussion focused on the potential opportunities for the federal government and industry to align themselves with and to assist Latin American countries in the harmonization of environmental standards and regulations that drive the environmental market. During the discourse on standards, the need for a clearer definition of "environmental technology" was raised. Audience members pointed out that "clean technologies" was not mentioned in the definition. If it was included or implied, how would government convey the importance of clean technology and let industry know of its benefits and suppliers? Lewis Reade, US-AEP, stated that the best way to reach out to industry about clean technology is through international cooperative efforts such as the American Committee 207 on ISO 1400, and trade associations. He urged that federal government pollution avoidance programs and process control people from companies link up. It is easier to define some environmental sectors, such as remediation and waste management, than others. The Organization for Economic and Cooperative Development is attempting to define avoidance technology. Concerning technologies that are internal to companies, it is difficult to discern what is a "regular" technology designed to enhance competitiveness and what is a pollution avoidance or waste minimization specific technology. The term "environmentally sound technologies" has been suggested, but it too involves some ambiguity.

Ann Alonzo said foreign country marketing information is collected and made available to U.S. firms from the DOC's Office of Environmental Technology Exports, the U.S. and Foreign Commercial Service and U.S. embassies (which need to be even more involved in publicizing and training locals about U.S. environmental technology).

Jessie Harris, DOE, commented that U.S. companies need to take a long-term approach to international marketing, and allow time to learn more about the culture and needs of a country and to develop lasting relationships. Howard Schirmer, CH2M Hill, said that the United States must take a long-term look at international markets. Competitors, like Japan and Germany, have already taken such an approach. The United States can be competitive by taking a long-term approach and by being flexible and adaptive.

Presentations on Finance

This panel centered on ways that American companies might obtain financial support for their exporting ventures. **Julie Belaga**, Director, Ex-Im Bank, chaired the finance panel and provided an overview of what Ex-Im Bank offers in terms of loans, guaranteed credit, and insurance for U.S. exporting companies. Ex-Im Bank does not target one industry sector particularly, but the environmental industry is gaining momentum. Currently, Ex-Im Bank offers approximately $17 billion in assistance; less than $1 billion supports environmental exports but deals will be expanding dramatically in the future. One of the constraints that U.S. companies must recognize when dealing with Ex-Im Bank is the requirement of reasonable assurance of repayment. Yet, Congress has allowed Ex-Im Bank to take risks where other U.S. banks cannot. Ex-Im Bank is not in competition with U.S. commercial banks, but works cooperatively with them. It deals with 150 countries and emphasizes working with developing countries.

Ex-Im Bank offers four basic services: working capital guarantees for small and medium exporters to build, buy, or assemble products; export credit insurance against commercial and political risk; loan guarantees; and direct and intermediary loans. Ex-Im Bank wants to work with U.S. companies. It may work on financing a large deal or a piece of it. In the past, Ex-Im Bank has been successful in helping to finance biomass projects in Russia, geothermal projects in the Philippines, and water and wastewater treatment work in the Third World. Presently, Ex-Im Bank is offering a new, short-term package for environmental companies that includes 95 percent coverage against commercial loss, 100 percent coverage against political loss, 15 percent coverage on local costs, and longer repayment terms.

Bosworth Dewey, OPIC, stated that most U.S. companies who break into the international marketplace are usually not companies with the best technologies, but are ones with the best financial packages. Entering a market is not a trade decision, it is a strategic decision. An important strategy that companies should employ is direct foreign investment. Why? Investment leads to trade and vice versa. However, tariffs and non-tariff barriers or lack of market information, customer service, etc., can keep a company out. At this time, OPIC assistance is not available in Mexico or China because of a lack of bilateral agreements with Mexico and human rights violations in China. For other markets, OPIC provides the following support: long term loans ($2–$200 million) for manufacturing and processing; insurance against political risk and the inconvertibility of currency; pre-investment activities, such as trade missions, feasibility studies (e.g., the Environmental Enterprises Development Initiative funds up to $100,000 per project for feasibility studies); and environmental investments (e.g., a paper/pulp mill adding a wastewater treatment facility to its site). OPIC sees it investment missions as opportunities to establish linkages, provide advocacy, and assist companies to penetrate markets. Currently, OPIC is working with DOE to conduct an energy and environment mission to India in 1995.

Ann McKinney, Director of Trade Programs, US-Export Council for Renewable Energy (ECRE), explained that ECRE is funded by the U.S. Agency for International Development (USAID) and DOE and leverages dollars to help companies along the project pipeline. The organization consists of manufacturing associations from six renewable energy sectors: wind, solar, biomass, energy efficiency, geothermal, and hydro. ECRE's prime activities include general outreach (publications, conferences, and workshops), market characterization (country profiles, trade events), market conditioning (technical assistance, training, policy support), project development (pilot projects, pre-feasibility studies, financing), and project support (project evaluation, operations and management training). ECRE actively recruits companies to participate and tracks projects to ensure their survival.

Fred Eberhart, Regional Director for Asia, TDA, described the role of the Asian Trade Development Agency as a small program with growing interest and budget. TDA spends about 80 percent of its budget funding grants for feasibility studies. It also provides export enhancement support by identifying and prioritizing key projects (50 percent environmental) and provides the technical assistance to help companies win foreign bids. Eberhart continued by explaining the TDA grant process and how a company can successfully win bids. He said that the *Commerce Business Daily* announces requests for project proposals, but the best way to stay on top of leads is through TDA's biweekly newsletter. In this publication are the announcements of "definitional missions" (DM), i.e., sending technical teams to a host country to evaluate possible projects. Generally, funded projects come out of these missions. Eberhart urged companies to contact the TDA country managers to obtain copies of DM reports. Each report provides the bidder with substantial information for competitively bidding a project. Furthermore, TDA will provide a grant to U.S. companies for three percent of the total amount of the proposal to offset unfair practices, such as subsidies, and to level the playing field between U.S. companies and host country business.

Discussion on Finance

Before open discussion took place, Ann Alonzo provided a summary of the panel's goals and what information had been shared so far. In Alonzo's synopsis, she outlined the U.S. Government's role in trade promotion. It is setting the stage and creating the climate to stimulate increased trade in environmental goods and services. It offers education and cooperation through training, gathers and disseminates information on markets to the private sector, and conducts trade missions and overseas demonstrations to showcase U.S. environmental products and match U.S. know-how with foreign needs. Finally, she added that the federal government, through its TPCC efforts, is working to coordinate federal agencies' environmental and trade promotion activities to leverage financial resources and to establish closer collaboration between the public and private sectors to avoid fragmentation/duplication and to achieve mutual export-related goals.

An audience member commented that although Ex-Im Bank, OPIC, and TDA are trying to create a seamless support structure, there is still a huge gap in financing U.S. business development causing the United States to lose to foreign competitors whose governments subsidize their industry development. The Japanese recognize the potential revenue stream from new innovative technologies and assist in creating new companies that become vertically integrated into a much larger giant, like Mitsubishi. Could the role of the U.S. Government be to facilitate the formation of such teams to compete against Japanese or German mega-corporations? Can there be relief from U.S. antitrust laws to allow U.S. companies to build the strength and capacity to compete against a Mitsubishi or a Siemens?

Julie Belaga, Ex-Im Bank, stated that the private sector should take the lead, with the federal government offering support. The problem with developing "consortia" is that U.S. companies are very independent and have an inclination to work and act alone. If U.S. companies see partnering as an effective mechanism to competing effectively abroad, they must not look at other U.S. companies as the competitors, but at Japan and Germany. U.S. companies have a greater inclination to partner with foreign companies than their own. A significant attitude adjustment must take place for the consortia idea to become truly effective, observed Belaga.

A representative from the renewable energy sector commended the federal government for its attempts to help industry. However, despite great opportunities, his major concern is that the federal government is not placing enough emphasis on renewable energy sources. Renewable energy

developers have the same need for long term financing, but do not receive the same competitive rates as other industry sectors do. **Julie Belaga** explained that she was not sure that the renewable energy product was competitive or had a real buyer. **Jessie Harris** said that DOE is focusing on energy technologies (including energy efficiency, renewables, and clean coal) appropriate to various countries' needs. With some renewables such as photovoltaic energy, many projects are developing the market for rural electrification. Today, tens of thousands of villagers throughout the developing countries have photovoltaic power, many helped by USAID, DOE, ECRE and other U.S. programs. There are over three billion poor people who need rural electrification. Increased demand will increase the scale of manufacturing and decrease the costs of photovoltaic systems, thus increasing the penetration of this renewable technology.

A venture capitalist from the audience commented that it is difficult for entrepreneurs to respond to developing country opportunities because they do not know what are "real" opportunities. How can entrepreneurs validate these opportunities? Can government help identify and finance these breaks? A TDA representative responded that if the requests result in specific projects, TDA may be able to assist. A State Department representative in the audience commented that the number one job of American embassies is to help U.S. companies prosper in the host country market, whether it is building relationships, providing cultural information and counsel, or identifying reputable entities that U.S. companies can do business with in that country.

A consultant focusing on Mongolia asked why TDA literature does not cite TDA funding limits, as well as the export multipliers which are used to evaluate proposals, for certain countries and regions, such as Central Asia. A TDA representative responded that these multipliers change frequently and the publications are designed to last over a period of time. However, in TDA publications there are phone numbers for U.S. companies to call to obtain the financial information they are looking for. TDA is looking for a significant return on U.S. dollars invested. For East Asia, the multiplier is 100 to 1. The consultant replied that this return requirement is so high, almost unrealistic, that it precludes many companies from participating abroad.

Another set of questions was posed from the audience: How do we focus and orient government support? On regions? Industry sectors? Or on customer solutions? **Lewis Reade** responded that regionalization is the answer. The demand side will determine direction and foci of U.S. trade. US-AEP has 50 people in the field in Asia gathering market information, but is still working on stimulating U.S. environmental industry interest to export to Asia. Only about 6,000 companies really want to export to Asia. These companies will be targeted through business-to-business seminars featuring successful U.S. exporters. Ann Alonzo said the same was happening for Mexico.

Bosworth Dewey stated that the U.S. Government cannot be everything to all people. He believes that growth is in the emerging markets and that the Germans and the Japanese are aggressively moving on these markets through seamless private partnerships. U.S. companies would be much more successful if they used similar methods and teamed with financial institutions. A fine example of a public-private partnering success is Raytheon Corporation's winning a bid on a SIVAM communications network project worth over $1 billion to monitor the Amazon in Brazil. DOC helped put the project pieces together, but Raytheon developed the team of businesses and other organizations who pooled their talents and resource to meet the challenge and competition. The Raytheon project is a model for how business should build public-private partnerships to win international business.

The federal government must recognize that private industry resents taxpayer money going to aid projects in developing countries, but U.S. companies do not get the work. **Lewis Reade** explained that U.S. firms win 72 percent of the Asian Development Bank projects they bid on; the problem is that U.S. companies only bid on three percent of the projects. How can we get more U.S. companies to bid? US-AEP recommends that small companies partner with larger companies until they have established a track record of success and can venture out on their own. Initially, the joining of forces helps companies through a complex export process.

Julie Belaga summarized the discussion. There is a superb array of services available to the private sector. Yet, there are additional needs to enhance what is already available. These include: focusing on priorities; engaging in two-way communication between government and business; identifying the impediments and frustrations to exporting and determining what government can and cannot do to help; eliminating U.S. fragmentation; and publicizing export successes.

Successes provide lessons learned and models for other export venturers to follow. Successes also stimulate greater export interest and motivate potential increased participation. Successes could also stimulate greater Congressional support for environmental trade promotion activities.

Facilitation Team

Diana Fox-Jackson, Waste Policy Institute (Rapporteur)
Craig O'Connor, Export-Import Bank (Discussion Rapporteur)
Camille Richardson, Department of Commerce (DOC) (Discussion Rapporteur)
Pete Swanson, Federal Mediation and Conciliation Service (Facilitator)
Ernesto Uribe, DOC (Session Planning)

Breakout Session 2
U. S. Environmental Technology Market Development and Diffusion

Co-Chairs: **Kelly Carnes, Deputy Assistant Secretary for Technology Policy, Department of Commerce (DOC)**
Stephen Gage, President, Cleveland Advanced Manufacturing Program

Panelists: **Elizabeth Parker, Director, Design for the Environment Program, U.S. Environmental Protection Agency (EPA)**
Marcia Kinter, Vice President for Government Affairs, Screen Printing Association
Clyde Frank, Deputy Assistant Secretary for Technology Development, Office of Environmental Management, Department of Energy (DOE)
Mike Dunn, President, BRADTEC
David Gold, Environmental Products Manager, Manufacturing Extension Partnership, National Institute for Standards and Technology (NIST), DOC
Iona McNamara, Permacharge Corporation
Maria Tikoff, Chief, Energy Productivity and Pollution Prevention Branch, Global Change Division, EPA
Fred Schoeneborn, Director, Corporate Facility Management, Mobil Oil Corporation
Mary Saunders, Assistant to the Director, Office of Standards Services, NIST, DOC
John Tao, Corporate Director, Environmental Technology Partnerships, Air Products Company
Jonathan Menes, Director, Office of Trade and Economic Analysis, DOC

Breakout Background

For many years, the federal government and industry have worked in partnership in a variety of technology areas. Initially, these partnerships were based on a model of government-as-customer. As government and industry realized that these programs had an impact on competitiveness, a number of partnerships have moved towards an industry-as-customer model. Today in the environmental technology area, there is a portfolio of partnership programs that have dual environmental improvement and competitiveness objectives. The partnerships came into existence on an ad hoc basis to meet varying technological objectives ranging from industrial processes that convey competitive advantages to efficient, effective site remediation technologies.

This breakout session focused on the ability of partnerships between the federal government and industry to create incentives for catalyzing technology commercialization and use; and to overcome market and regulatory barriers to technology innovation and diffusion. As a basis for discussion, the initial portion of the session highlighted four partnerships having dual environmental improvement and competitiveness objectives, but with unique foci and approaches. In addition, two federal government programs were discussed that are building information sources that can be used to strengthen and increase the effectiveness of government-industry partnerships. Following the presentations and discussions of these established partnerships and information base programs, session participants addressed these questions: (1) How do partnerships create incentives for

innovation and diffusion? Can they be vehicles for overcoming barriers to commercialization and diffusion? (2) What information and organizational infrastructure is needed to enhance these partnerships?

Summary of Key Issues and Suggested Actions

- Partnerships are positive and powerful mechanisms that create incentives for the commercialization and use of environmental technologies. Partnerships are effective for building trust and opening lines of communication/dialogue among all stakeholders. It is important that they be inclusive of all stakeholders.

- Small- and medium-sized businesses need to have user-friendly information at a regional level, e.g., the National Institute for Standards and Technology (NIST) Manufacturing Extension Partnership (MEP), Small Business Development Centers (SBDCs), and other programs. Regional clusters provide easy access to information for manufacturers and other businesses.

- The U.S. Government should focus responsibility for environmental industry market development partnerships into one agency outside the U.S. Environmental Protection Agency (EPA).

- There is a need for government to become less opaque and complex to small businesses and less difficult for small businesses to participate in procurements and other programs.

- Better coordination is needed between federal and state regulatory and technology-related programs.

- A government-private sector approach is needed to define and collect environmental business/technical information.

- The federal government should build market-driven partnerships that increase the ability of U.S. industry to compete and that apply business criteria to focus industry's efforts.

Session Presentations

Partnership Models

Four existing government-industry environmental technology partnership programs were discussed. The programs and their presenters are as follows:

- Design for the Environment Program (EPA)

  - **Elizabeth Parker**, Director of Design for the Environment Program, EPA
  - **Marcia Kinter**, Vice President for Government Affairs, Screen Printing Association

- Technology Development Leveraged Partnerships (DOE)

  - **Clyde Frank**, Deputy Assistant Secretary for Technology Development, Office of Environmental Management, DOE
  - **Mike Dunn**, President, BRADTEC

- Manufacturing Extension Partnership (MEP) (NIST/DOC)

  - **David Gold**, Environmental Products Manager, MEP, NIST, DOC
  - **Iona McNamara**, Permacharge Corporation

- Green Light/Energy Star Programs (EPA)

  - **Maria Tikoff**, Chief, Energy Productivity and Pollution Prevention Branch, Global Change Division, EPA
  - **Fred Schoeneborn**, Director, Corporate Facility Management, Mobil Oil Corporation

Highlights of the discussion that followed these presentations are as follows:

- Such partnerships provide forums to enable discussion of common issues across competitive barriers.

- Partnerships provide incentives and outreach that serve as a "carrot" to dispel the legacy of the government "stick."

- Partnerships help reduce the time to take a technology to market and are a vehicle for risk-sharing, helping industries to be competitive.

- There is a particular need to use partnerships to help companies get through the "valley of death," such as by supporting full-scale demonstrations, thereby assuring regulators and investors of technology viability.

- More coordination is needed among government agencies (and within agencies) on technology development.

- A partnership issue is how to measure success, e.g., jobs created, competitiveness gains?

- The Technology Reinvestment Program and other technology programs should accommodate more small companies and smaller projects than at present.

- The role of the states in partnerships needs to be emphasized and expanded. State consortia and the leveraging of state resources should be increased.

- Federal agencies should publicize the benefits of partnerships to their clients and to the Congress.

Strengthening the Information Base

Additional presentations covered two government efforts intended to strengthen and increase the reach of information available to technology developers:

- Support for International Organization for Standardization (ISO) Environmental Management Activities (DOC)

  - **Mary Saunders**, Assistant to the Director, Office of Standards Services (NIST/DOC)

- **John Tao**, Corporate Director, Environmental Technology Partnerships, Air Products Company

- Support for Efforts to Characterize the Environmental Industry and Market (DOC)

  - **Jonathan Menes**, Director, Office of Trade and Economic Analysis, DOC

Highlights of the discussion that followed these presentations are as follows:

- Disaggregated information is needed for marketing, especially by small businesses.
- Federal programs need to employ more than a technology push strategy. Government should help define markets.
- The government should rely on companies to define the application of and need for environmental market data.
- The private sector has an excellent capability to develop marketing information (e.g., by "following the money").
- Statistical information is needed by the private sector on end use applications of environmental technologies and services as well as information about products.
- The federal government needs to be proactive with regard to the states (matching funds).
- Partnerships need to share liabilities as well as benefits.
- A goal of environmental technology partnerships should be to reduce the time between laboratory demonstration and market competitiveness.
- There is a need to define and broaden government missions toward commercialization.
- Consideration should be given to some form of government financing (especially for small businesses) for environmental projects in those countries that pose a high market risk.

Discussion Summary

Following are the responses from two sub-groups, each of which addressed different questions.

How do partnerships create incentives for innovation and diffusion? Can they be vehicles for overcoming barriers to commercialization and diffusion?

- While the technical assistance programs are very beneficial, the hard question in an era of limited resources is how to set priorities among the needs for the various programs, and how to replicate these assistance programs beyond the federal government.
- More dialogue is needed between government and the private sector.
- In developing partnerships, the focus must be on what customers need and want. In particular, an atmosphere should be created that allows small companies to partner with the government. Such

companies cannot afford to spend time on paperwork required for partnering; they want government help—not hindrance.

- In the technological pipeline, are we locking into what is now available, versus what the future may bring?
- How can the gap be bridged between proprietary information and sharing know-how?
- Trust building and communication is the bottom line.
- In exploring barriers we may be missing key players, e.g., the labor force. To avoid parochialism, we must identify and expand the number of stakeholders involved.
- State trade development activities are a huge resource that can be tapped.
- The U.S. Government should be sensitized to recognize that answers to long-range environmental problems are outside the United States. Part of the solution is to export our environmental expertise.
- Partnering with the federal government has a drawback: loss of flexibility. How can the federal government interact with industry in a businesslike manner?
- How can incentives be created for federal or state governments to use lower-cost technologies?
- How do we link markets to need? Historically, this has been done through the regulatory process. All actions now should be geared toward making the U.S. environmental industry more competitive.
- State and federal regulations are inconsistent, and regulations differ from industry to industry.
- Small business assistance programs at the national laboratories need to be expanded. The federal government can give true technology assistance to small businesses that is very cost-effective.
- There is a need to think more about joint R&D. Industry also needs to start sharing. How can the federal government help with information interchange?
- The federal government must have a roadmap which clarifies where it wants to go
- Part of partnering is knowing what the market is (demand-pull). If the federal laboratories knew the top ten environmental problems for each of, say, fifty industries, they could better focus their R&D.
- Let us start simple to build trust, solve today's problems, and form a vision of where to go.
- To overcome or ameliorate the "valley of death," we should talk in terms of technology business for a sustainable future. In other words, what does the market need?

What information and organizational infrastructure is needed to enhance these partnerships?

The discussants first identified the following key elements that are required of any organizational infrastructure designed to enhance partnerships: clear lines of communication, well-defined lines of authority/responsibility, clear regulatory lines of control, clearly-defined financial system, and dissemination of timely information. Once this framework was established, specific needs were addressed. These included:

- Ongoing partnership programs need to be assessed to identify those that are effective and to determine what types of partnering programs or arrangements in which government should be involved.

- EPA should not be involved in partnerships with the environmental industry, but rather should focus on its regulatory function. Responsibility for environmental industry partnerships should be focused outside of the EPA.

- A federal interagency coordinating mechanism should be established to help identify environmental markets, streamline partnering arrangements with the environmental industry, and remove or reduce the potential for duplication of efforts among agencies.

- Government should clarify and simplify the procedures for industry to work with the government.

- The federal government should give money to the states and let the states be responsible for enhancing industry partnerships.

- An industrial consortium should be formed to address ISO 14000 and to form an ISO training framework.

- An ISO 14000 curriculum should be established for engineering courses and programs.

- There is a need for a government-private sector mechanism to define the requirements for an environmental business/technology database (e.g., markets, products, service classifications).

- An important priority must be creating a mechanism to tailor environmental business/technology data to small business needs.

- The NIST-MEP and SBDCs can be major tools in adapting information to small businesses and in serving as information "hubs" for environmental data, technology information, and business advice.

Facilitation Team

David Berg, Department of Commerce (Session Planning)
John Clark, Pacific Northwest Laboratory (Facilitator, Organizational Infrastructure Discussion)
JoAnn Haviland, Financial Management Service, Department of the Treasury (Session Facilitator)
Andy Levine, Science Applications International Corporation (Rapporteur)
Rob Vagnetti, Waste Policy Institute (Assistant Rapporteur)

Breakout Session 3
Financing Environmental Technology

Co-Chairs: **Jeffrey Hunker, Senior Policy Advisor to the Secretary of Commerce**
Paul Hardiman, Division Executive-Environmental Services, Bank of Boston

Panelists: **John Preston, Massachusetts Institute of Technology**
Allen Mandel, Small Business Administration (SBA)
Paul Zofnass, Environmental Financial Consulting Group, Inc.
John Schoefield, Thermatrix
Hugh Hollman, Alex Brown and Sons, Inc.
Frank Pope, Technology Funding

Breakout Background

Developing and commercializing the technologies for a sustainable future requires capital—both from private capital markets, and from government sources. Ensuring that these technologies have adequate capital support is an objective of the emerging environmental technology strategy. The federal government devotes substantial resources to basic technology research and the private sector devotes substantial resources to commercialization. However, neither sufficiently funds the critical phases of technology development between these poles: the demonstration phase. Government plays a large role at all stages of environmental technology development and its policies define both the existence and size of current and future markets for environmental solutions. It remains vital that government actions do not unintentionally restrict the supply of capital to the environmental sector by adding significant and difficult-to-analyze dimensions to the riskiness of investment projects.

Government policies affect the size and growth of environmental technologies markets—directly, through regulation and enforcement, and indirectly, as in encouraging a shift towards pollution avoidance. Small or shrinking markets are less likely to attract investments in new solutions. Changes in fiscal policy can potentially stimulate additional investment in environmental technologies. The Research and Experimentation Tax Credit, for example, stimulates such investments in all types of technology. More focused approaches exist such as the Dutch example which allows for accelerated depreciation of selected environmental technologies.

Summary of Key Issues and Suggested Actions

- There is clearly a financing problem for environmental technologies. This funding gap impacting the development of environmental technologies is most critical at the demonstration phase, between basic technology research and substantial capital resource infusion for commercialization.

- The volatility of the regulatory structure has deterred greater participation of the capital markets. Performance measures are not applied with any degree of uniformity. It is unclear which agencies are developing the regulations—greater consistency is needed. Efforts such as the Western Governors' Association (WGA) cross-state permitting efforts need more support by the Clinton Administration.

- An Environmental Technology Bank (Envirobank) should be created to provide a wide variety of financing to small environmental technology businesses. The bank would operate as a small business investment company (SBIC), licensed and regulated by the Small Business Administration (SBA), but would be a privately owned and managed investment firm.

- There is continued uncertainty in being able to characterize and define the scope and breadth of the environmental market. There is no accurate data on the size of the market. The information that is available is stale and misleading.

- Process technology, a shift from "end of pipe" solutions to pollution avoidance solutions, has led to a shift in emphasis from regulation to economics and placed an emphasis on greater process knowledge.

- The opportunity to get technology out of big companies presents a real potential (i.e., new providers of solutions are the providers of new business).

Session Presentations

Session Co-Chair **Paul Hardiman**, Bank of Boston, opened the session by welcoming the attendees. Session Co-Chair **Jeffrey Hunker**, Department of Commerce, framed the session discussion by stating that the issues in financing environmental technologies are essentially defined by the following three questions:

(1) Does the existing environmental policy framework, especially time lags and uncertainties of the permitting process, create additional perceived risks that reduce capital availability?

(2) Does the current environmental policy framework create the proper incentives—particularly in terms of the size and growth rate of markets for environmental technologies?

(3) What additional actions should be taken—beyond increasing the supply of capital, e.g., making changes in tax policy.

Presentations centered on the following four key issues: (1) overarching frameworks for evaluating actions to increase domestic capital; (2) impact of the current environmental policy framework on financing; (3) market size and growth as an incentive for growth; and (4) other options for increasing investment.

Issue 1 - Overarching Frameworks for Evaluating Actions to Increase Domestic Capital

John Preston, Massachusetts Institute of Technology, began by discussing the market imperfections for financing environmental technologies. At present, the investment environment favors speculators who seek a quick return on their investments. He noted that family-owned businesses tend to be more long-term oriented and consequently have a more long-term investment strategy. Publicly-held companies, on the other hand, tend to have shorter-term views focusing on quarterly profits. Preston referred to this as the "MBA syndrome." He also discussed the funding gap, sometimes referred to as the "valley of death," that occurs when environmental technologies reach the bench scale testing phase of the R&D continuum. Preston concluded by stating that the capital gains tax, regulatory restructuring, and additional government help in financing the "funding gap" should be addressed and examined as possible solutions.

Allen Mandel, SBA, began by discussing the financing barriers in the environmental technology industry and noted that this industry sector is being driven almost entirely by regulations which has created an uncertainty in the permitting and approval process. Furthermore, there is a need for a U.S. Environmental Protection Agency-approved certification process. The industry needs to move away from specific technologies towards performance-based standards. A fragmented regulatory process among states has driven up the cost of doing business. The issue of liability for environmental cleanup remains a barrier. Mandel discussed several policy alternatives to help overcome the financing barriers:

- An Envirobank could provide a wide variety of financing mechanisms to small environmental technology businesses. The bank would be an SBIC, licensed and regulated by the SBA, and could operate as a privately owned and managed investment firm. The bank would use its own funds, as well as funds obtained by borrowing at favorable rates with an SBA guarantee and by selling preferred stock to SBA, to make venture capital investments in small businesses. The SBIC would provide equity capital, long-term loans, debt-equity investments, and management assistance to qualifying small businesses.

- There needs to be more effective use of the federal government's Small Business Innovation Research (SBIR) program with regard to environmental technology. The SBIR program was designed to assist small technology-based firms that are in the "valley of death" stage of their development. Each federal agency with an extramural R&D budget in excess of $100 million must establish an SBIR program, under which it sets aside at least 1.5 percent of its R&D budget in 1993 and 1994, at least two percent in 1995 and 1996, and not less than 2.5 percent per year thereafter. Eleven agencies currently participate.

- The lack of information available to lenders is an impediment to the flow of capital into small environmental technology companies. If a lender is not comfortable with his understanding of the amount of risk involved in a business, it is not prudent for him to make a loan. There exists across the country many organizations that could be oriented to provide information and technical assistance to lenders on various aspects of environmental technology. Assistance would include, for technology developers, an assessment of a firm's technology (both the technology it is selling and the technology it uses to manufacture what it sells) and management. Concerning users of environmental technology, the assessment would focus on the technology to be purchased by a firm, its technical feasibility and its effect on the firm's rate of return.

John Schoefield, Thermatrix, noted that there was some danger in the SBA proposal for an Envirobank because he perceived that there was an insufficient amount of capital to enable small technology firms to "get around the curve." In other words, they would not be able to get through the commercialization process because of the tremendous amount of funding needed. He noted that as the industry moves from "end of pipe" towards newer technologies, financing with no clear evidence of a market is difficult.

Issue 2 - Impact of the Current Environmental Policy Framework on Financing

Paul Hardiman noted that commercial banking has had long experience in the environmental technology industry. Very few banks today are financing new technologies. Principal reasons cited included concern of the lending institutions about the regulatory environment and the long lead time necessary to obtain a license or an approval; user lack of willingness to use new technologies; and

the insufficient rate of return on environmental stocks. He cited the need for consistency/predictability in the market; consistency/predictability in the cash flow of companies; greater depth of market; and greater certainty in regulations.

Paul Zofnass, Environmental Financial Consulting Group, Inc., commented from the perspective of the engineering and consulting sector. That sector is a $10 billion to $20 billion industry and accounts for approximately ten percent of the environmental industry. He noted that this market is driven largely by environmental markets which are highly volatile. The single largest constraint on this industry sector is the fluctuations from one incoming presidential administration to the next. He also noted that the engineering and consulting sector has been hit hard, with stocks being reduced to less than one-half of their value in the last two years. As to why capital is scarce, three reasons were given: volatility; lack of business experience; and the relative size of most of the companies as compared to others in the capital markets. Two possible solutions were offered: attempt to bridge the "election cycle," and reduce uncertainty and volatility. If both of these are achieved, capital would likely flow back.

Issue 3 - Market Size and Growth as an Incentive for Investment

John Schoefield noted that environmental technology stocks are at an all-time low with four of the six that went public in 1993 having lost 60 to 85 percent of their value; the remaining two stocks are still in the Initial Public Offering (IPO) stage and have not made any sales. From his point of view, having spoken to 166 investment companies, there are no real incentives for investing in environmental technologies. The principal reason is the apparent lack of any significant market for technologies. Furthermore, in the last two to three years there has been a shift away from investments in environmental control technologies towards more cost efficient pollution avoidance and waste minimization "process" technologies. There is also mounting evidence of large companies setting up internal corporations to handle "end of pipe" problems. Technologies being developed today, to handle "end of pipe" solutions, are not the ones needed to handle pollution prevention issues.

Hugh Holman, Alex Brown and Sons, Inc., addressed three questions: (1) Do emerging technologies exist? (2) Are they investable? (3) Are they conducive to financing? He stated that good candidates for raising funds through the equity markets include firms that have good business strategies and that can provide a return on investment. He noted that financing was leaning away from companies that depend on federal government remediation work and leaning toward companies whose environmental products can be utilized by the private sector. Factors to take into account when trying to finance a company include size of the opportunity, time to commercialization (can the product get to market in three to five years?), the investment required, the risk of changing regulations, and ease of exit for investors (can they recoup their investment when they want?).

Issue 4 - Other Options for Increasing Investment

Frank Pope, Technology Funding, stated that most venture capitalists are not going to be interested in investing in environmental technologies unless they are guaranteed significant returns on their investments. The marketplace is a difficult one, where a "faster, quicker, cheaper" technology does not guarantee success. He noted that there is a need for a more comprehensive approach at the outset in addressing the issue of financing environmental technologies. While there is a lot of good technology available, it resides in the R&D shops of big corporations. Government has a role to play in increasing investment in this sector, by defining "how clean is clean" and by resolving the liability issue. Key factors which affect a company's ability to secure successful financing include good

market knowledge; resource availability; knowledge of technologies already available; demonstrated evidence of a cost savings technology; and the impacts of existing regulations and liability problems.

Discussion Summary

The following strategy/solution ideas emerged from the discussions among the breakout participants:

- Develop risk-based analysis.
- Achieve greater consistency in the development/application of regulations.
- Establish a set of standards for industry performance.
- Emphasize investment in technologies for soil/groundwater bifurcation.
- Standardize the approach to regulatory sign-off.
- Establish a consortium of industries for greater information exchange.
- Obtain greater Clinton Administration support for WGA cross-state permitting efforts.
- Collect and disseminate accurate data on the relative size of the environmental market. The available information is usually stale and misleading. More timely release of information is needed in order to address questions and concerns of institutional investors.
- Create a government-sponsored industry consortia managed by a venture capital company acting as the commercialization agent. This would provide an appropriate forum for cross-sector fertilization and information exchange.

Following is a synopsis of written comments and suggestions to this question posed to breakout session participants: "If you had three minutes with Vice President Gore, what would you say to him?"

- Moving technology from the R&D level to commercialization, especially removing barriers to commercialization, will require a national policy and strong leadership from the federal government.
- The number one barrier is regulatory uncertainty. Investors must be convinced that an investment in environmental technology will produce a return on investment before an existing regulation is changed to render obsolete the technology (grandfathering technologies, etc.).
- The second major barrier is capital formation. Investors will not invest until much of the risk is eliminated. This could be done by utilizing Department of Energy and Department of Defense sites as test beds. Indemnification from strict liability while demonstrating a technology on a federal site must be provided. Also, the federal government should establish performance criteria up front that, if met, will lead to commercialization. There currently exists too much of a "bring me another rock" by the regulators, and technology developers never know when they are finished! This situation must be changed.

- The Clinton Administration should assign the national laboratories and government agencies a "National Strategic Mission" in support of environmental technology development and commercialization (much like the "Man Mars Mission"). The role of the labs should include "up front high risk," R&D or proof of concept for which there is little if any private capital being invested. The federal government should advocate cost sharing. As technology moves through the pipeline from "high risk" towards "new commercialization," there should be cost sharing; e.g., 20 percent private/commercial and 80 percent federal up front. As technology moves through the pipeline, the trend should be reversed. The federal government should reward performance and provide incentives to lab directors to transfer technology.

- Government should be encouraged to provide more funding for pilot plant demonstrations where availability of funding from other sources is at its lowest.

- Care is necessary in designing an Envirobank. No one wants a government-run venture capital fund. Government should catalyze, not lead development.

- Existing accounting regulations and capital formation objectives are geared towards short-term results and return on investment. This runs contrary to financing commercial development and implementation.

Facilitation Team

Lisa McKnight, Department of Commerce (Session Planning)
Richard Rogers, Waste Policy Institute (Rapporteur)
Elizabeth Whitley, Department of the Treasury (Facilitator)

Breakout Session 4
Building International Markets for Environmental Technologies

Co-Chairs: **Jefferson Seabright, U.S. Agency for International Development (USAID)**
Scott Sklar, U.S. Export Council for Renewable Energy (US-ECRE)

Breakout Background

Critical to the U.S. role as an environmental steward and to the long-term success of U.S. environmental technologies is a global orientation and outlook. By the year 2000, more than 60 percent of the global market for environmental goods and services will lie outside the United States and four out of five people will live in developing countries. Any comprehensive effort to facilitate the development and dissemination of environmental technologies will require efforts to build the global capacity to develop, trade, utilize, and maintain goods. Local capacity to make environmentally and economically sound investments can be fostered through policy and regulatory reform, as well as training and education. Financial mechanisms can be created at home and abroad to decrease the risk of investment. Each of these activities builds local capacity to develop and use environmentally sustainable management techniques.

Summary of Key Issues and Suggested Actions

- Government has an important role to play in creating demand for environmental technologies and facilitating information exchange.

- Key to creating markets and promoting environmental stewardship is building the capacity of people to understand environmental problems and use technology to solve those problems.

- Successful market development requires an integrated approach. Training programs need to be linked to information dissemination efforts and demonstration projects. Research needs to be tied to demonstrations and to programs that facilitate commercialization of technologies.

- Market development efforts can better serve clients (foreign nations, large and small businesses, and other governmental partners) through partnerships and information exchange.

Session Presentations

Co-Chair **Jefferson Seabright**, USAID, explained that by assisting countries to develop in an environmentally sound manner, the United States helps to support development while at the same time driving the creation of markets for environmental technology; the United States "does well by doing good." Further, he expressed hope that the discussion at this conference, and this session in particular, would help the U.S. Government better coordinate its activities to help drive demand for environmental technologies with efforts to foster the supply of U.S. goods abroad. He noted that USAID is looking at the role technology will play in addressing problems of the next century. It is critical to generate technology that is affordable and adaptable to varied local conditions. Seabright asserted that USAID promotes the diffusion of environmental technologies in a number of different ways: building markets through activities to disseminate and exchange information; providing training; building capacity; assisting policy and regulatory reform; supporting R&D; facilitating

financing; and establishing demonstration and pilot projects. These efforts all help create an "enabling environment" for the trade of environmental technologies. There are many specific examples of USAID programs that have created demand for new technology. Two examples noted were the wind/energy power plant in Costa Rica that leveraged funding and ushered private power into the country; and a small-scale pollution prevention effort in the Czech Republic that decreased pollution through the application of U.S. technology and resulted in significant financial savings to the Czech companies involved.

Co-Chair **Scott Sklar**, US-ECRE, noted that government agencies have a definite role to play in building markets. Governments should facilitate the relationship between the customer and industry, but they should not interfere with that relationship. The United States is now exporting approximately 70 percent of its environmental technologies products to developing countries. He noted that USAID's role in the renewable energy arena is commendable because they have successfully worked to demonstrate the benefit of private power and thereby helped to open new markets. However, USAID missions are often behind the times in their awareness and understanding of new technology and, as a result, they cannot serve as effective sources of information on new environmental technologies and market opportunities. Sklar briefly assessed the role of key agencies in exporting of environmental technologies. He commended the U.S. Environmental Protection Agency (EPA) for its role in endorsing private sector leaders, but added that EPA needed to focus more on driving markets. While the Department of Energy (DOE) has helped agencies work more closely together, it needs to play a larger role in filling the gaps that exist in governmental programming. The State Department continues to do an excellent job in the international policymaking arena, but it needs to better inform the public of new environmental agreements. Government agencies should invest more money in training, communications and other innovative activities in order to engage the customer.

William Nitze, EPA, stated that EPA does its job best domestically, but is not yet known as a trendsetter internationally. Domestically, EPA is effective in setting guidelines which reduce emissions in the environment. Those standards drive environmental markets. He noted that standards are only one part of the solution. Countries may have good environmental regulations, but they are usually not enforced because the local infrastructure does not allow it. EPA, Nitze noted, will continue to work to perfect its domestic programs and create a broad set of goals that can then be adapted by other countries. The "Common Sense" initiative is one example of a cost-effective way to build international markets. The Environmental Technology Institute is another example of a program that is industry-driven and involves training by the industry that later translates into sales.

Rafe Pomerance, U.S. Department of State, explained that the U.S. Government is interested in fostering the adoption of international policies that promote environmental awareness and activities, while also enhancing U.S. commercial interests. The world's concern about environmental protection helps to drive the world's market. Global environmental treaties such as the Montreal Protocol and the Vienna Convention allow alternative technologies to be brought to the market. Where we have large global problems, like climate change, we also have enormous opportunities. For example, in the areas of biodiversity/biotechnology all agree that action is needed to preserve the loss of species. Most also see the potentially enormous agricultural and pharmaceutical product export market that might be created. The careful crafting of international agreements is needed to serve economic and environmental interests.

Discussion Summary

Major observations from the discussions are as follows:

- Small business representatives need to be better served. Federal agency programs and experts must be responsive to their needs and concerns. For example, one participant wanted to know what program opportunities exist for small businesses to take advantage of. Specifically, how can small entrepreneurs access the technical experts to assist them in building overseas markets for new technologies?

- Agency representatives recognized that small business needs often fall through the cracks. While there is no single source of information and assistance within the federal government for small businesses, the possibility of a "one-stop shop" for business representatives was discussed as one possible solution. Whatever the solution, it would be difficult to ensure that all government programs and activities were adequately covered to meet the needs of small businesses.

- A philosophical change in thinking by USAID, EPA, and the State Department was noted. These three agencies were not previously involved in business development. However, since the fall of Communism these agencies have been redefining their missions and looking at the opportunities to achieve multiple goals simultaneously.

- Government should attempt to balance its assistance efforts for both large and small companies. The two are not exclusive. For example, government officials play a critical role in closing big deals, but might also play a larger role in helping smaller companies. Both groups need government assistance, but different kinds.

R&D, Facilitating Financing, Demonstration/Pilot Project Establishment

Jefferson Seabright, USAID, and **Scott Sklar**, US-ECRE, were discussion leaders.

DOE representative **Ron Bowes** began by using the Committee on Renewable Energy Commerce and Trade (CORECT) as an example of government's responsiveness to small businesses. CORECT is an interagency working group of 14 federal agencies that pools expertise and resources to provide assistance to the U.S. renewable energy industry helping firms increase exports. Bowes noted that the Russian Federation is an example of a place where government can play a role. He said that currently, there is almost no market for renewable energy in Russia. U.S. assistance in the establishment of standards could drive market development. Government agencies could work with companies by disseminating information, and then as the markets evolve, by helping facilitate local capacity development and the adoption of appropriate technology (e.g., USAID might provide training or EPA might assist pre-feasibility studies).

Additional points made during this discussion include:

- The role of educational institutions in building international markets has not yet been clearly defined, but like government agencies, academia is relied upon by industry to provide technical assistance and information.

- Interest was expressed in the possibility of a single agency to handle technology promotion for international markets. In the interim, participants felt that current staff need to become more

familiar with environmental technology issues. A mechanism for helping finance technologies has to be created. Bureaucratic processes have to be streamlined. Government agencies need to assist at the pre-investment stage more and should also help facilitate the bundling of projects for consideration.

- Government can provide networks and facilitate access, but industry needs to provide financing.

Information Dissemination and Exchange, Training and Capacity Building, Policy and Regulatory Reform

William Nitze, EPA, and **Rafe Pomerance**, State Department, were discussion leaders. Points made during this discussion include:

- Information dissemination and exchange are important, but no single model is clearly most effective. Electronic means of communication such as electronic mail and the Internet are important technological developments which can enhance the ability of professionals to communicate across borders. However, many counterparts in developing countries do not have the capacity or skills to take advantage of such technology.

- Training and institutional capacity building were cited as fundamental building blocks for technology diffusion and viable markets. Well-trained professionals are necessary to build the institutional capacity and economic and regulatory infrastructure required for future markets. Potential customers must be both well-informed and capable of performing economic and technical analyses, and able to implement and operate environmental technologies. Customers generally do not buy things they do not understand or cannot operate.

- Public-private partnerships and collaboration were cited as important means of ensuring that government and industry are working together to build international markets. EPA's new "Common Sense" model of domestic regulatory reform was cited as a model of public/private partnership that could be useful in working with developing countries. It would enable new technological and regulatory advances to be transferred to developing countries, while assuring that public- and private-sector decision makers in those countries were involved.

- Environmental technology was identified as a solution to environmental problems and not a "Holy Grail" to be pursued for its own sake. Government and industry must help countries identify their environmental problems and the solutions to those problems. It is important not to promote technologies solely because they are advocated in the United States. Not all U.S. products are useful to other countries.

- Industry has been more successful in marketing products and services when potential customers have been partners in resolving problems rather than sales targets. Government's role is to facilitate partnerships for solving problems between the United States and developing countries.

Facilitation Team

Tom Colosi, American Arbitration Association (Facilitator)
Carla Koppell, U.S. Agency for International Development (USAID) (Session Planning)
Robin Mackar, USAID (Rapporteur)
Mark Murray, USAID (Assistant Rapporteur)
Kim Sais, USAID (Assistant Rapporteur)

Breakout Session 5
R&D to Commercialization Continuum

Co-Chairs: **Joseph Bordogna, Assistant Director for Engineering, National Science Foundation (NSF)**
Tom Malone, Director, Sigma Xi, The Scientific Research Society

Panelists: **John Mansfield, National Aeronautics and Space Administration (NASA)**
Frank Murray, Science, Space and Technology Committee, U.S. House of Representatives
Linda Pratt, San Diego County, California
John Preston, Massachusetts Institute of Technology
Marcia Rorke, Mohawk Research Corporation

Breakout Background

The interagency Joint Subcommittee on Environmental Technologies (JSET) of the National Science and Technology Council (NSTC) has developed a comprehensive strategy and implementation plan to guide federal environmental technology research and development (R&D). In this plan, developed through an extensive interagency process, the JSET embraces the vision that social, economic, and environmental values must be integrated in a systematic fashion to achieve long-term economic growth while sustaining and improving the environment. This group sees the federal government's role as facilitating innovation and stimulating a shift from incrementalism to technological transformation, from managing waste to sustaining and restoring ecosystems, and from reacting to environmental and public health threats to anticipating and preventing these threats. Integrating these environmental goals with economic goals requires an environmental technology strategy that ultimately will help industry shift from waste management to pollution avoidance. This forward-looking approach will stimulate companies to become more competitive by lowering their energy and resource needs while reducing or eliminating their waste cleanup and disposal costs. Nationally, the strategy will help create economic prosperity by energizing the rapidly growing domestic market for clean technologies and focusing industrial resources on investment in new plants and equipment. Globally, the strategy will position the United States to take a leading role in developing countries to help them leapfrog directly to sustainable technologies in many industrial and service sectors.

Summary of Key Issues and Suggested Actions

- The environmental R&D strategy needs to be clearly articulated to the general public, so that it will receive popular support in Congress. As the need to justify expenditures of public funds becomes more challenging in an increasingly rigorous budget environment, communications are critical. Successful R&D programs must be more visible to the public and to decision makers. The message must be relevant, compelling, and understandable by the public, industry, and Congress.

- The federal government should establish a long-term R&D plan that focuses available funding on priority technology areas selected by risk-based criteria and developed in partnership with the private sector. The strategy should be an industry-led, opportunity-driven, government-facilitated

environmental technology effort that creates jobs and wealth while simultaneously protecting the environment.

- The federal government should take the lead in funding long-term, expensive, and/or high risk research and proof of concept or pilot projects.

- The federal government should move quickly to remove barriers that hamper industry's ability to innovate and deploy more effective technologies. Low technology solutions can be just as effective as high technology solutions, but barriers and liability risks sometimes prevent their use.

- The federal government's current permit-conscious culture should begin moving toward one of monitoring compliance.

- The federal government should develop more effective ways for government and the private sector, in partnership, to make long-term investments and share development risks, especially between concept refinement, scale-up, and commercial market entry.

- The federal R&D strategy must balance the urgent need for near-term solutions to remediation problems with long-term research for sustainability.

- Small businesses are largely being ignored because the magnitude of the gains made at individual sites are not substantial. Small business cannot cost share the way a major corporation can, so costs may have to be spread over the whole industry or consortium of companies. Small businesses have trouble learning what federal government assistance is available and how to access it.

- The federal government should consider shifting the tax laws' capital gains treatment to provide incentives for long-term instead of short-term investments. Due to the size of pension funds (over a trillion dollars compared to venture capital funds of $2–3 billion), they should be taxed to move them into long-term investments.

- The federal government needs to spend more time linking actual user needs at the state and local level with potential solutions. By working through communities and getting close to the real problems, the public can provide the needed reality check to the proposed programs. Federal resources should be linked to state and local resources.

Session Presentations

Session Co-Chair **Joseph Bordogna**, NSF, introduced the session by noting that in most of the 20th century businesses have been able to survive by applying only two of three product criteria: good, fast, or cheap. Now in the latter part of the century, all three criteria are required to be competitive. In the next century, a fourth criterion must be applied to survive—clean. He noted that there are numerous trends and issues affecting the direction of R&D in a dramatically changed world. Some of these issues include: data explosion, global economy, international competition, finite resources, environmental imperatives, demographic shifts, infrastructure renewal, shared wealth, dual use, defense reinvestment, diverse workforce, and cognitive revolution. The national challenge is to concurrently innovate and create wealth while maintaining the environment. Only through the integration of science, technology, and engineering within the context of societal needs dictated by governmental policies and the constraints of economic realities can solutions be found. The federal

government is trying to decide how best it can help, and what partnerships are needed to be successful. To foster this integration, the Clinton Administration has reorganized its federal R&D policy planning organization into the National Science and Technology Council (NSTC) and its nine committees to determine the priorities for the $70 billion federal R&D budget. The JSET treats in a holistic fashion the approximately $7 billion environmental R&D budget falling within the purview of two NSTC committees: the Committee for the Environment and Natural Resources (CENR) and the Committee for Civilian Industrial Technology (CCIT). Environmental technologies are divided into four categories for classification: avoidance, control, remediation, and monitoring and assessment. Current JSET planning indicates that R&D expenditures for remediation and control technologies will begin to decrease after 2000 as avoidance and monitoring/assessment expenditures increase. After 2010 all R&D requirements may begin to decline.

Bordogna highlighted the vision statement from the JSET report as well as generally accepted definitions for sustainable development, environmental technology, and the environmental technology categories set forth in the July 1994 report, *Technology for a Sustainable Future: A Framework for Action*. The JSET strategy, subtitled "Innovation Through Integration," is organized in terms of challenges or issues within three groupings: enablers, new systems paradigms, and recovery paradigms. The challenges under "enablers" are: enabling commercialization; verification processes and programs; infrastructure requirements; and risk assessment and ecological valuation. The "new systems paradigms" are: industrial ecology; clean energy, alternative energy; materials for industrial ecology; reinventing the urban environment; natural hazards; and environmental biotechnology. The "recovery paradigms" are: restoring habitat and sustaining biodiversity; and subsurface environmental restoration. At the conclusion of Bordogna's presentation, a macro question was formulated for the panel to consider: **How would you recommend the federal government invest approximately $7 billion annually to enable industry to define and implement the next generation of environmental technology?**

John Mansfield stated that there should be two goals for the R&D strategy: forge partnerships and fund R&D appropriate to the level of development. Based on his experience at NASA, he said that the federal government needs to be realistic. The United States allows the states to set regulations and companies adapt to each state's requirements. In contrast, in Germany government sets risk-based standards and industry designs technology to meet these standards. If a company only meets the requirements in one state, they are open to competition. But, if a U.S. company meets more broadly-based standards, it will be more competitive. The government needs to understand its customers. Who does it serve? What are the customer's needs? The government needs to be smart about its contracting arrangements if it wants to have effective partnerships. The old fashioned contracts with which the government used to procure things do not work. In sponsoring R&D, the government has an important role in moderating the risk for the industrial partner.

Frank Murray presented his views on how the new Congress is likely to view requests for R&D funds for environmental technologies. He believes there will be a change in focus. The new Congress is likely to be predisposed to reduce costs and the size of government, to make government less intrusive, and to return responsibility to individuals and to state and local governments. Even in the last Congress, environmental legislation, like the Green Technology Bill, was held up because too many "hot buttons" were touched, e.g., private property rights, cost-benefit analysis, risk assessment, and federal mandates. These issues are likely to be swept up into dogmatic debates. To achieve Congressional support, "technology for a sustainable future" needs to have industrial support, user support, and state and local government support. Any environmental legislation is likely to have a difficult battle in Congress, but it may be possible to remove much of the political "hype" and

salvage important key elements that have bipartisan support. Murray also noted with respect to government-sponsored R&D that it is very effective in being good and clean, but does not have an impressive record in being fast and cheap.

Linda Pratt cautioned that communities are unique in their needs for environmental technologies. There is a danger in designing for the "average" state and not being able to perform well in any. Technology needs to be put where it will be used and then a process needs to be in place so recommendations can be made for continuous improvement. She also noted that the technology transfer phase of development lacks funding from the government. Another concern is that the overwhelming amount of data and choices available to users can leave them paralyzed. There needs to be a better matching of end users and environmental products. Federal information resources need to have accessible local links.

Marcia Rorke emphasized two concerns: risk and communication. Which risks does government need to moderate? Technology risks, financial risks (intellectual property), or market risks? Government may need to consider each to varying degrees. Poor communication between those in government and the private sector is a barrier to partnering. For example, government and the private sector use different jargon and key phrases.

John Preston discussed the funding gap that occurs when environmental technologies reach the bench scale testing phase of the R&D continuum. Additional money will not likely come from the federal government's budget, so the balance must be supplied from private sources. Government can have an impact on directing private investment toward the long term. Currently the incentives favor speculators who want quick returns on their investments. Studies have shown that family-owned businesses tend to be more concerned about the long-term viability of their company and have a more long-term investment strategy. Publicly-held companies tend to have a short-term view focusing on quarterly profits. The federal government could change the incentives so investors will change their investment behavior to focus on the long term as is done in other countries such as Japan.

Before opening the discussion up to the breakout session participants, Bordogna indicated that previous regional workshops had identified three recurring areas of emphasis relevant to this session. These included:

- An integrated systems approach to pollution avoidance is essential.
- Sustainable communities is an important area for discussion.
- Partnerships among the federal government, states, local communities, industry, consumers and non-government organizations (NGOs) are necessary for environmental technology development.

Discussion Summary

- There should be more discussion about why R&D expenditures relating to environmental technology are needed. A compelling case has not been made to the public. A clear vision must be communicated that captures the imagination. Complex issues need to be explained in terms the average citizen can comprehend. Environmental technology need not be an oxymoron. The JSET strategy document needs to be written for the layman, not the career government bureaucrat. There is a need to "defog" the prose.

- Environmental technology's driver is no longer improving the quality of life, but one of cost savings and creation of jobs and wealth.

- To resolve public support issues, more time needs to be spent linking actual user needs at the state and local level with potential solutions. By working through communities, it may be easier to get the message across. By being close to the real problems, the public can provide the needed "reality check" with regard to the proposed programs. Federal resources should be linked to state and local resources.

- Today, it is difficult to see how the priorities are being set. The R&D program needs to be government-facilitated, industry-led, opportunity-driven, and job-related. The public sees government entitlement programs out of control. It is important that the public make the distinction between R&D and entitlement programs.

- Even though the Clinton Administration has encouraged federal agencies to develop partnerships with industry, each agency structures those partnerships based on the agency's unique culture and tradition. R&D funds need to be spent where they can achieve significant accomplishments, but they should not be spread thinly over too many programs. Fewer well-funded programs are more desirable. A better industry-led peer review process could help set the priorities.

- Remediation success stories have not been well-publicized, because the news media is only interested in uncovering major failures. Successes are not news. The public and others in government have the erroneous opinion that the remediation program is not working. "The sky is not falling." In fact, remediation work is only just beginning, and there are success stories. However, there are still R&D needs for remediation technologies even though the JSET strategy seems to emphasize avoidance technologies. There must be balance in the R&D program with regard to remediation and avoidance technologies.

- Some portion of the R&D budget should be set aside for high risk, long-term, fundamental research that could have high payoffs.

- The incentive to invest in environmental technologies is significantly impacted by the regulatory environment. The permitting process needs to be improved. The regulatory environment should move from a permitting culture to one of monitoring compliance. Regulation standards cannot be established by whoever gets the most air time on television; standards need to be based on science. Low technology solutions can be just as effective as high technology solutions, but are sometimes hampered by regulatory barriers and liability issues.

- Some of the environmental technology funding shortfall may be met with funds from Small Business Innovative Research (SBIR) grants. The program could grow from approximately $1 billion to $1.5 billion.

- Small businesses need help in improving their processes. They are largely being ignored because the magnitude of the gains made at individual sites are not substantial. Small business cannot cost share the way a major corporation can. Costs may have to be spread over the whole industry or a consortium of companies. Small businesses have trouble learning what federal government assistance is available and how to access it.

- Education and training are needed as part of the long term strategy. Academia needs to be included in the R&D planning thought process.

- It is important to recognize that technology does not do any good unless someone uses it. Early adapters have the most exposure to risk, so there should be incentives for them. Participants disagreed as to the extent government should be a partner to winning or losing. The Canadian government collects the profits on successful technology developments, but also suffers losses when they fail. This kind of arrangement would be a significant departure from current practice in the United States. Nevertheless, the federal government needs to support risky research.

- The federal government's budget cycle needs to be multi-year, not the six month budget cycle it seems to be now. In order to develop new technology, a longer, sustained, committed funding plan needs to be established.

- Some participants felt that the federal government should not get involved in technology commercialization and should "just get out of the way." Other participants felt that the Department of Commerce's National Institute for Standards and Technology and the Department of Defense's Advanced Research Projects Agency have been helpful.

- Some participants felt that the federal government's energy policy was not focused and was not receiving much attention. Energy production and use have a major impact on the environment. Energy demand is growing worldwide. There are many benefits from considering energy and the environment together and developing low or no emissions energy sources as well as increasing the efficiency of energy use through all sectors of the economy. Some felt that the federal government's solution was natural gas.

- It makes sense for the federal government to support environmental technology development because there have been more jobs created in that sector than other high profile sectors like biotechnology.

- The federal government should consider shifting the tax laws' capital gains treatment to provide incentives for long-term instead of short-term investments. Currently, pension funds are not taxed, and they are not invested for the long term. These funds are invested in "wealth shifting" investments (like real estate) and not "wealth creating" investments (like small technology company startups).

Facilitation Team

Julie Leap, Waste Policy Institute (Assistant Rapporteur)
Dave Patterson, Waste Policy Institute (Rapporteur)
Susan Shearhouse, Federal Mediation and Conciliation Service (Facilitator)
Kathy Steele, Department of the Treasury (Assistant Facilitator)
Jim Waddell, Department of Energy (Session Planning)

Breakout Session 6
Verification and Testing of Environmental Technologies

Co-Chairs: **Robert Huggett, Assistant Administrator, Office of Research and Development, U.S. Environmental Protection Agency (EPA)**
James Mahoney, Senior Vice President, IT Corporation

Breakout Background

One of the major impediments to the commercialization and use of innovative environmental technologies is the lack of performance and cost data that are acceptable to the buyers and permitters of the technologies. New technologies—no matter how badly needed, technically feasible, or cost-effective—enter the highly regulated and litigious environmental marketplace with a burden of proof that is difficult to overcome. Even after establishing efficacy in one or more locations, new technologies frequently face the cost and time of proving performance over and over again as sales are sought in other companies, communities, states, or nations.

The federal government is interested in working with all interested stakeholders in designing and executing a responsive, cost-effective technology verification program that produces readily accessible data of the highest credibility that can be recognized by those responsible for making environmental technology and permitting decisions.

Summary of Key Issues and Suggested Actions

- The development and verification of high caliber cost, schedule, and performance data is integral to the acceptance and diffusion of environmental technologies.

- Impediments to environmental technology market penetration include: downward trend in the investment cycle; normal investment risks; and the fact that the typical "investment pursuit curve" is challenged by a massively complex network of regulations preceding and governing full-scale demonstrations.

- Effective verification approaches can reduce the legal, fiscal, and technological risks of using innovative environmental technologies.

- Because of the need to examine and deal with the full range of verification issues in developing the National Environmental Technology Strategy, a focused workshop on verification should be held.

- Before verification of environmental technologies can occur, there needs to be agreement on standards for measurement.

- Protocols are necessary to assure the credibility of technology verification, but to the fullest extent possible, these should be configured to address broader categories rather than specific technologies to be tested.

- Flexible verification programs, employing a wide range of credible, third-party verification entities—working in concert with federal, state, and/or local representatives—are the preferred mode of operation.

- Potential third-party verification entities include: private testing organizations (e.g., Underwriter's Laboratory), national laboratories, non-profits, and universities.

- Stakeholder input, derived from active participation throughout the demonstration and testing process, is integral to success.

- In the site remediation arena, multiple demonstrations spanning many potential applications, under varying conditions (especially with respect to contaminant media), are generally needed to achieve sufficient replication and demonstrate technology viability.

- Government should play a role in the verification process, and must bear at least some elements of cost. For example, there is a need for federal "set-asides" to fund remediation technology demonstrations at federal facilities.

- There is a need to foster a managerial approach within government (and in industry, where needed) that encourages and rewards risk taking, and accepts innovative technology failures, particularly during the technology demonstration phase.

- There is a need for greater federal and state reciprocity of verified data and conclusions derived from successful demonstrations.

Discussion Summary

During this breakout session, three sub-groups examined these issues: (1) pollution prevention technology verification; (2) site remediation technology verification; and (3) control technology verification. In general, there was broad agreement that definitive testing and verification are integral to successful environmental technology commercialization.

Issue 1 - Pollution Prevention Technology Verification

Questions were raised as to the purpose and customer identity in a pollution prevention verification process. Certain pollution prevention processes appear amenable for verification, but it is not clear that verification is needed or desired. Should site-wide discharge standards exist, however, a pollution prevention verification program would be quite valuable. While all stakeholders need to be involved, there is a clear desire for technology developers and industry to assume a prominent role in the development and implementation of a verification process, with government playing a small role, if any. Overall, it was agreed that metrics for pollution prevention should be clearly defined, that the process not hamper ongoing efforts, that state/local reciprocity be ensured, and that the process apply to site management processes as well as technology performance. Developing verification approaches for monitoring technologies should also be explored. Other points were made:

- It is important to avoid "locking in" certain verification processes, thus ensuring future inefficiencies by curbing innovations. Hence, in a regulatory context, flexibility in verification is essential.

- Agreement is needed regarding verification measurements (e.g., flow rates, etc.).

- Opinions were expressed that government should consider leaving the ultimate responsibility for achieving verification in the hands of the technology developers themselves.

- It is difficult to measure the effects of pollution prevention without having a basis for comparison (need a baseline to measure before/after facility performance; measure "end-of-pipe" output against baseline).

- Presently, there is too much emphasis on emissions. It is necessary to measure not only pollution levels but toxicity levels.

- Pollution prevention approaches entail a series of economic and environmental trade-offs. Many feel that economics are the principal driver.

- Investment returns, specifically the "payback" rate over time, are important when evaluating preferred pollution prevention options (i.e., pollution prevention tends to require long payback horizons).

- Full-cost accounting is integral to measuring the success of pollution prevention, but companies are reluctant to divulge such information.

- Although verification is clearly appropriate in determining technology viability, it is difficult to verify process effectiveness.

- If there were discharge performance standards (e.g., "bubble concept"), verifying process performance would make sense.

- Mandating pollution prevention, in a "command and control" sense, may be too prescriptive. Industry must have the flexibility, and the government should provide sufficient incentives, to enable process modifications and reduce emissions/discharges.

- Verification processes differ with respect to pollution prevention and site remediation (emphasis on site management practices/processes as opposed to technical performance of individual technologies/remediation systems).

- In striving toward increased pollution prevention, site-wide emissions/discharge reduction requirements could be beneficial.

- A concern was expressed that EPA programs may "handcuff" or inhibit industry pollution prevention efforts if certain verification proposals are advanced.

- EPA or third-party verifiers should define certain ground rules, standards, and/or test methods to facilitate verification of the effectiveness of pollution prevention measures.

- Potential unintended effects of process/system changes must be considered; hence, continuous monitoring is essential.

- Roles of third-party verifiers may need to be technology-specific, with potentially different groups of stakeholders involved along the way.

- Pollution prevention verification needs to be voluntary, not mandated, and certification is not necessary (pollution prevention is a process, not an end-point, capable of achieving "beyond compliance" reductions in emissions/discharges).

- Although there is value in establishing reciprocity, there will be diminishing returns if the process slows down regulatory approval.

- Establishing credibility is important, and reciprocity can be achieved where there are credible verification processes.

- In terms of desired roles and responsibilities for pollution prevention verification, industry should assume a prominent role in achieving verification; government, to the extent practical, should not interfere; and all stakeholders need to be involved.

- Regarding measurements and verification of pollution prevention, there needs to be: agreement on what should be measured (e.g., amount, cost, toxicity); customer/user buy-in; and emphasis on site-wide criteria.

- Whether verifying for compliance or "beyond compliance," industry needs to focus on verifying that risks to human health and safety, and environmental risks, have been reduced.

Issue 2 - Site Remediation Technology Verification

This sub-group reached the following three conclusions: (1) there is a need to establish a federal "set-aside" program for technology demonstrations at federal facilities to promote risk sharing; (2) protocols for testing problems, not technologies, should be established; and (3) reciprocity needs to become a national goal and advanced (e.g., through federal-state partnerships such as the Federal Advisory Committee to Develop On-Site Innovative Technologies).

Much of the discussion focused around the issue of testing protocols. Specifically, there was uncertainty as to how verification related to, for example, "value" and "credibility" and "measures of success" and "verification versus certification." The problem with addressing the issue may have been one of semantics and differences over the precise definitions for the above terms. The sub-group discussion and interactions focused on major issues associated with "verification."

From a scientific/technical standpoint, there was much discussion about the need to clearly define the expected/forecasted/predicted test and demonstration outcomes. Not everyone seemed to understand that point, and some may have confused that with "performance measures" as they relate to final clean-up standards. The point is, the first step is to define and understand what data are required, and what results are "forecasted." The next step is to write the test plan to ensure that test objectives are met. Data gathering is expensive, so it is imperative to focus on gathering only the data that is necessary to resolve questions and forecast acceptable outcomes.

In addition, protocols should be made to be as generally applicable as possible. The group was in agreement that protocols should not be tied to single technologies. Rather, it will be necessary to tie the protocols to environmental problem areas (e.g., petroleum in sandy soils). If this is done well,

then one set of protocols could apply to a range of relevant technologies that may come along. This flexibility will influence the potential for reciprocity as well. In short, there needs to be a further push to encourage regulators, states, communities, stakeholders, consulting engineers, and the users themselves to accept technology performance results from other sites and pursue potential applications of such technologies at their sites. Federal-state cooperation between the Western Governors' Association (WGA) and four federal agencies, pursued through the Federal Advisory Committee to Develop On-Site Innovative Technologies (FAC-DOIT) was cited as an example of the kind of partnership that can advance innovative environmental technology demonstration, verification, and application.

This sub-group felt there is too much emphasis placed on rigid clean-up standards and approved technologies. Verification of new technologies involves a certain amount of risk, and current approaches place the majority of risk on the contractors and clean-up agents. Hence, there ought to be a federal sites, facilities, and funding set-aside where government and contractors can share the risk of demonstrating new technologies. If we seek new innovations to control and/or reduce the costs of environmental compliance, everyone has to agree to assume certain risks and accept a certain percentage of technology failures.

These additional points were made:

- A principal reason for the site remediation verification "credibility gap" is the fact that technologies are rarely successfully demonstrated more than once, and regulators as well as stakeholders need to be won over.

- In addition to replicating demonstration results at a given site, it is essential to successfully demonstrate remediation technologies at more than one site in different environmental media for the verification process to have real meaning.

Issue 3 - Control Technology Verification

This sub-group identified numerous hurdles to technology verification including: difficulty in obtaining "full-scale" technology data due to insufficient technology "scale-up" funds; the need in many instances to embrace holistic, not incremental, approaches to verification; insufficient regional EPA participation in technology demonstrations; inherent difficulty in moving a technology from the bench/pilot scale to the demonstration scale; and the potentially high costs of verification.

This sub-group also felt that technology verification and certification must be specific for it to be of value; however, verification specificity will also tend to limit the range of verified technology applications. In addition, flexibility is viewed as a critical component in the control technology verification process, and the sub-group felt that third-party verification could accelerate the process. With respect to costs, participants felt that if verification and certification processes are perceived as valuable by technology developers (e.g., California/EPA's AB 2060 Certification Program), private dollars will flow into the certification process and leverage dedicated government resources.

With respect to measures of success, the group felt control technology verification processes will not succeed if they are applied in a "pass/fail" manner. Rather, the sub-group felt measures of success should focus on improvements in technology performance, cost, and operating parameters. In closing, the sub-group agreed that incremental approaches should be encouraged and that technology verification should be a voluntary, rather than mandatory, process. Other points raised included:

- Although advancing holistic approaches to facility management is a worthy goal, incremental steps to pollution control verification will continue to be an interim focus.

- A pollution control verification regime must be flexible enough to address new tools.

- Pollution control verification should focus more on technology performance measurement and evaluation than actual certification (the most rigid form of verification).

- Customers "buy" compliance, and since verification can lend credibility to innovative technologies, developers are then able to "sell" compliance.

- Verification is often viewed as a means for accelerating the permitting process.

- Some in the technology development community are wary that technology certification may lead to additional liabilities in the future if innovative technologies subsequently falter.

- EPA's definition for verification and Cal/EPA's definition for certification are virtually the same.

- Impediments spawned by verification include those instances where the limits of a given technology are specified.

- Specific technology limits vary per application, and the more specificity one has, the less value there is in verification.

- Recertification of technologies, especially with incremental improvements, can present significant hurdles to technology acceptance and use.

- A best available control technology (BACT) verification regime can present impediments to innovative technology use, and it is not clear how certification can be efficiently achieved with respect to incremental process improvements.

- Regulations should not be configured in a "pass/fail" regime, whether one is dealing with "leap frog" or merely incremental technology advancements.

- If a verification process is viewed as valuable by the technology development community (e.g., Cal/EPA's AB 2060 Certification Program), private companies will expend resources to leverage government dollars already being spent in this area (similarly, if the process is valued, there is less of a problem in securing investor information for verification).

Facilitation Team

Kevin Easley, Waste Policy Institute (WPI) (Rapporteur)
Penny Hansen, U.S. Environmental Protection Agency (Session Planning)
Ed Sedlmeier, Federal Mediation and Conciliation Service (Facilitator)
Aaron Weisbord, WPI (Assistant Rapporteur)

Breakout Session 7
Regulatory Policy

Co-Chairs: **David Gardiner, Administrator for Policy, Planning and Evaluation, U.S. Environmental Protection Agency (EPA)**
Eugene Berman, Vice President for Regulatory and Community Affairs, Molten Metal Technology, Inc.

Breakout Background

The participants in this breakout session included key environmental technology players from industry, state, and federal agencies. A senior representative from EPA co-chaired the session and presented a broad overview of the various problems in regulatory policy development. The other co-chair was a leading industry representative who depicted the barriers to commercialization from the point of view of a regulated developer of an innovative technology. The presentations emphasized that markets for environmental technologies are shaped, stimulated, and sometimes inhibited by environmental regulations.

The session focused on the need to review environmental policies and procedures in order to identify specific steps to reduce government-imposed barriers to the development and commercialization of environmental technology. The session identified regulatory barriers to commercialization, and suggested possible next steps that government could adopt in encouraging the development of innovative technologies.

Summary of Key Issues and Suggested Actions

- Government needs to set flexible, performance-based requirements and "get out of the way." There should be fewer "command and control" technology-based requirements. However, there should be no flexibility without accountability.

- "Culture change" is necessary in both government and industry. Regulators must view technology innovation proactively and consider the impact of regulatory actions on the development and diffusion of new technologies. Mutual trust must be developed between government and industry.

- "Risk-sharing" between government and industry should be emphasized. There must be a balance between "risk" and "reward." The government should expand the use of "credits" for superior performances, on the one hand, and remove disincentives to technology development on the other.

- Regulations, lengthy permitting procedures, and regulatory standards that lock-in existing technologies are inflexible, overly prescriptive, unpredictable, and burdensome.

- Increased coordination among agencies is needed to consolidate permit processing, set up one-stop shops, and eliminate duplicative reviews. Agencies should adopt a customer service orientation.

- Government should take an active part in expanding opportunities for experimentation and pilot projects involving innovative permitting and other processes (e.g., multi-site permitting). Initiatives should target discrete geographical areas, and involve federal facilities when possible.

Session Presentations

Session Co-Chair **Eugene Berman**, Molten Metal Technology, Inc., opened the session with a brief synopsis of some of the regulatory barriers his company encountered in bringing catalytic extraction and recycling technology to demonstration and commercialization. Berman depicted Molten Metal's five-year road to commercialization of its recycling technology as time-consuming and costly, and emphasized that without his company's large budget the commercialization efforts would have failed due to lack of funding. Although Berman described the traversing of regulations as costly and time-consuming, he said that, "90 percent of what we did [development procedures] we would have done anyway to develop our technology; the regulators didn't make us do it." Today, while not yet achieving profitability, Molten Metal's efforts have resulted in the first hazardous waste recycling facility in Massachusetts.

Due to the risk and sensitivity issues surrounding the Molten Metal technology—recycling through catalytic-extraction—the company has successfully implemented public participation and risk communication as an integral part of its commercial development strategy. Molten Metal's corporate philosophy, as depicted by Berman, is one of inclusion and openness. Molten Metal set up public meetings to provide stakeholders with information about the safety, performance, and the recycling process of the innovative technology. Berman explained that without an effective line of communication and outreach to the stakeholders, the Molten Metal technology would never have been implemented.

Berman highlighted another key component of his company's successful commercialization program as being the utilization of a certification process for their technology. This process allowed their technology to avoid the pitfalls of repetitive demonstration and continual validation. Molten Metal encountered in Texas and California state-run technical certification programs that gave their technology an expedited "stamp of approval" within the respective states.

Session Co-Chair **David Gardiner**, U.S. EPA, presented an overview of the regulatory barriers to innovation as identified in earlier Technology For a Sustainable Future workshops and EPA surveys of various industries. These barriers to innovation include: (1) an inflexible and overly prescriptive regulatory framework; (2) a burdensome and unpredictable regulatory process; (3) risk-aversion and intolerance of failure; (4) information deficiencies resulting in a negative public acceptance level and inconsistent enforcement; and (5) the need for the adversarial regulatory process to look at what has been done correctly.

Gardiner emphasized in his presentation EPA's commitment to the process of moving away from technology-based standards that lock-in existing technologies, toward instituting performance-based standards that will open up the accessibility of the market to innovative environmental technologies. Gardiner also identified two new programs the EPA is developing to promote flexibility through alternative and multi-site permitting, i.e., the Permitting Improvement Task and the Common Sense Initiative (CSI). The CSI fosters an industry-wide regulatory approach through partnering with six industries.

Discussion Summary

- Government should give credit to companies exceeding requirements in the form of tax incentives or regulatory credit points that would permit longer compliance time schedules, allowing for the full development time of new technologies.

- Government should expand the use of market-based programs (e.g., emissions trading and pollution fees) and continue to emphasize voluntary programs. More opportunities need to be created to allow for voluntary public-private partnerships which use market-based instruments.

- Since small businesses are less capable than large businesses of taking advantage of regulatory flexibility, government needs to take into account the financial resources of a business along with the projected effectiveness of a new technology and provide outlets and programs to enable worthy technologies to limit the cost of demonstrations and development.

- There is a need to create additional incentives for pollution prevention technology opportunities that are lost because end-of-pipe reductions still apply.

- Successful governmental regulations that can act as models include: performance-based goals for chlorofluorocarbons (CFC) reductions; market-based phase-down of lead in gasoline; thresholds and regulations that create incentives to come in below de minimis levels; and, increasing state flexibility by avoiding prescriptive technological requirements under the Clean Air Act's Inspection and Maintenance Program for autos.

- To achieve successful commercialization of innovative technologies government needs to provide comprehensive liability protection and indemnification for industry (including third party suits) and employ innovative approaches, e.g., the use of administrative penalties instead of jail time.

- Though waivers enable technologies to fast-track to commercialization, they create the impression of skirting requirements. Regulators should therefore promote flexibility through alternative means, such as banking extra reductions in advance as a contingency measure or providing environmental offsets as compensation for failed efforts.

- A culture for innovation needs to be encouraged by government agencies in establishing "safe harbors" to facilitate demonstrations of innovative technologies. The EPA's Common Sense Initiative (CSI) is an example of such a program that is attempting to encourage innovation in technology. The CSI program fosters an industry-wide regulatory approach by partnering with six industries (auto manufacturing, computers and electronics, iron and steel, metal plating and finishing, oil refining, and printing) and seeks consensus-based approaches that are "cleaner, cheaper, and smarter." These approaches are developed in conjunction with local community interests (to satisfy environmental justice concerns and secure public acceptance), industry representatives, and state and local as well as federal representatives, all under the auspices of the Federal Advisory Committee Act (FACA).

- Government needs to increase coordination among federal agencies and at the state level. There is a need to consolidate permit processing, set up one-stop shops, and eliminate duplicative reviews. Agencies should adopt more of a "customer service" orientation.

- Regulators should provide more information to the regulated industry, and an information dissemination effort should be undertaken to make information available to the public to increase "literacy" concerning environmental regulations and decrease "mis-information" concerning not only existing technologies, but new technologies as well. Health and ecological risk assessment methodologies need to be better known to the public and regulated industries.

- Government needs to use federal facilities as customers and test beds for environmental technologies and launching points for exportation.

- It is important for government to establish long-term environmental goals with built-in programs encouraging innovation.

- Government needs to create a less adversarial atmosphere between the regulated and the regulators, following the models of foreign governments that have created successful government-industry partnerships in commercializing environmental technologies.

- If innovation is going to take place, congressional legislation coupled with government agency cooperation is going to have to be coordinated and implemented on a regional and national level.

Facilitation Team

Corey Cooke, Waste Policy Institute (WPI) (Assistant Rapporteur)
Barry Elman, U.S. Environmental Protection Agency (EPA) (Session Planning)
Sandra Panetta, EPA (Session Planning)
Brad Penney, WPI (Rapporteur)
Zell Steever, U. S. Department of the Interior (Facilitator)

Breakout Session 8
Environmental Monitoring and Information Access

Co-Chairs: **Charles Kennel, Associate Administrator for Mission to Planet Earth, National Aeronautics and Space Administration (NASA)**
Robert Winokur, Assistant Administrator for Satellite and Information Services, National Oceanic and Atmospheric Administration (NOAA), Department of Commerce
Kass Green, President, Pacific Meridian Resources Corporation

Breakout Background

The challenges and the government role associated with the specifics of environmental technology information dissemination (developing, storing, obtaining, interpreting, and sharing environmental monitoring and environmental technology data) created great interest at previous workshops and symposia.

Many participants stressed the need for a wide range of easy to use information-sharing mechanisms, as well as the need for information-sharing partnerships. However, views differed regarding the needed types of information, the dissemination techniques to use, and the extent of the federal government's role.

This breakout session addressed the government's role as a provider of considerable environmental data that is a source of interest to a broad range of users and critical to American communities beginning to address sustainability.

Local end users need integrated information to support environmentally sound decisions. It is important for the federal government to disseminate information on specific environmental technologies through information clearinghouses.

There is an important role for government in collecting environmental data in areas such as risk, environmental value, and ecosystem management. Such a role is important to those who make land use decisions, such as local governments, large landowners (e.g., farmers), and residential construction industry representatives.

The federal government already has the infrastructure for many information-related tasks which local governments and industry often cannot afford, such as using satellites for environmental monitoring. Local governments see a new era with increasing local demand for and use of federal environmental data, now that information technologies and computer techniques have made such data less expensive and more accessible.

There is a need to strengthen information links between the federal and local governments to develop sustainable infrastructures and communities in the future.

Environmental organizations have emphasized the importance of the federal role in environmental monitoring, assessment, and information-sharing programs, such as the National Biological Survey

(NBS), because of the need to understand and maintain human and ecological health to achieve a sustainable future.

Local governments stress the need for environmental decision making and computer tools, such as decision support systems. They believe the federal government could play a role in helping to develop information technology and data standards, such as Geographical Information System (GIS) format standards, so that different data users, whether in government agencies or industry, could share and integrate data more easily.

Like environmental awareness, information outreach and dissemination efforts are seen as integral to many other policy efforts for promoting the development and implementation of environmental technologies.

NOTE: The breakout session was principally focused on environmental monitoring technology and information. It did not address other types of environmental technology development, nor dissemination of information on environmental technology outside of the environmental monitoring arena.

The summary below integrates the output from general session presentations and remarks, as well as from three sub-groups discussions which treated, respectively, the matters of:

a. Information systems, data access, and dissemination issues.

b. An agenda for environmental research and technology dissemination.

c. Barriers to partnerships in environmental monitoring.

Summary of Key Issues and Suggested Actions

- Environmental monitoring data should be integrated with social and economic data if it is to be of use to a broad range of state, local, regional, national, and international users. Because of the need to integrate information with environmental monitoring data, additional data must be obtained from a wide variety of sources to be useful.

- Environmental monitoring information needs to be agency non-specific, continuously supplied, and of "courtroom quality" to meet the needs of industry and municipalities. The sources include federal environmental monitoring organizations (NASA and NOAA), the Census Bureau, the Departments of Labor and Energy, other federal agencies, and local, state, international, and commercial sources. Environmental data fusion and dissemination is a perfect scenario for government-industry partnerships.

- Access to information is rapidly becoming paperless; however, a large number of people still do not have adequate access to Internet. CD-ROM media appears to be a gap-filler until technology, training, and infrastructure provide the truly universal information superhighway access. Intermediary assistance providers and libraries also can provide an interim capability.

- With regard to the R&D of environmental monitoring technology, continued investment is needed to develop sensors and analytical systems to keep pace with an explosion in available data. Federal priorities should be set, then integrated with commercial needs, to develop areas for dual use and collaborative, cost-saving, "win-win" efforts between government and industry.

- Partnerships are needed to integrate the resources, data sources, processing, and display technology, as well as to distribute the benefits in a more cost-effective manner. Orchestration is needed by federal leadership. The federal government has a role in establishing an open architecture of systems and standards.

- Time is of the essence in identifying global environmental risks and communicating these to local governments where development decisions are made daily.

Session Summary

- The explosion in data resources must be met with a vigorous R&D agenda to produce analytical and interpretive tools that can keep pace with the voluminous environmental monitoring information deluge. Sensor technology and analytical systems must continue to be developed to facilitate the ever increasing analytical demands placed on the data resources.

- The White House's Office of Science and Technology Policy (OSTP) should establish policy to prioritize federal environmental technology R&D requirements, focusing on an acceptable set of priorities for observations, analysis, data management, and technology R&D.

- Such priorities should be established as a collaborative effort among all appropriate federal agencies with a lead agency designated for each area of R&D. Once the federal agenda is set, it can be harmonized with the private sector agenda to develop areas of synergy and can lead to collaboration and partnerships.

- Environmental monitoring programs should include continued development of baseline information technology models and statistical design.

- This session highlighted the situation where municipalities throughout the nation are required to provide environmental monitoring-related information and other geographic-based information to meet regulatory requirements of the U.S. Environmental Protection Agency, Department of Energy, Department of Transportation, Federal Emergency Management Agency, and other federal bodies, yet the regulatory branches of these agencies will not accept the environmental monitoring data in the format already provided by other federal agencies, particularly NASA and NOAA.

- Currently, there is no focus in the federal government for spatial information systems research. Such research involves modeling and statistical studies (spatial statistical applications are different than conventional statistical techniques).

- There is no federal entity assigned responsibility for creation and maintenance of geographical information on other countries. Available information is incomplete and haphazardly collected and maintained. This situation is part of the more general problem of the lack of a baseline against which land cover change can be evaluated. As a result, there is no integrated map of topography, population, land cover, and transportation infrastructure.

- The federal government has not come to grips with the relationship among monitoring, research, and operations. The result is that monitoring is often regarded as operations, not R&D, when it is really essential to both. This has implications for program funding, continuity, and management.

- Legislative, regulatory, and other political factors too often result in frozen technologies. Regulations which mandate specific measurement approaches impede the advancement of better measurement technologies.

- Currently, most of our observation programs collect "vital signs" data; these are the less expensive, non-intrusive techniques. But in order to detect change before damage is done, there is a need to go beyond this level to collect process data. For example, monitoring the level of ozone has succeeded in the development of a mitigation strategy, but it took 75 years to go from problem identification to resolution. If chlorofluorocarbon (CFC) concentrations had been monitored for a longer period of time, the CFC problem might have been resolved sooner.

- New management and funding approaches are needed to increase the utility of the vast amounts of data collected. One way is to establish a fixed percentage of program costs for R&D. Another is to establish such a percentage for calibration/validation. A correlative, ground truth measurement program should be a part of each satellite program. Data collected must be in a form usable by modelers.

- Differing time frames pose significant barriers to public-private cooperation in R&D. Federal agencies tend to fund two to three year grants, while the average development period is eight years, graduate students are around for four to five years, and assistant professors are usually around for seven years. Public-private partnerships involving government at all levels, industry, and academia will help to align these differing time frames, shortening development times.

- There is a need to combine scientists across disciplines with engineers in the building of instruments.

- Research in analytical and interpretive tools must be pursued to cope with data explosion.

- Further development in sensor technology and analytical systems is needed to facilitate analyses.

- The critical importance to sustainable development of R&D and maintenance of global data should be included in the charters of appropriate federal agencies.

- Remote sensing measurement programs need to include significant and ongoing calibrated, correlated validating measurement components.

- Environmental monitoring programs should include continued development of baseline environmental monitoring information technology models and statistical design.

- Because of the wide variety of data types and potential users, partnerships are needed to integrate environmental monitoring and information resources as well as distribute them in a cost-effective manner.

- Federal leadership is needed in establishing an open architecture of systems and standards. Stakeholders from state and local government, industry, academia, and non-government organizations should be involved in the deliberations on creating this architecture.

- There is a need to bring together the federal regulatory agencies with the federal data providers and the regulated community to agree on what federal data is acceptable for mandated federal reporting.

- Keys to overcoming partnership barriers include: clear goals definition; shared control for mutual ownership; shared credit for successes; early identification of potential partners; a bottoms-up approach to management; flexibility; and empowering decision making at the lowest possible level (federal, state, local, and private sector) where expertise exists.

- An information manual on how to create successful partnerships should be published, to include case histories both successful and unsuccessful.

- Seed money should continue to be provided by government programs to help start-ups overcome the financial "valley of death."

- Common environmental monitoring goals should be established to enable the integration of federal, state, and local information and meeting the needs of all users.

- The Federal Acquisition Regulations (FARs) should be reformed to facilitate the creation of partnerships with all levels of government and industry.

- Federal agency data providers should conduct market surveys to identify the users, needs, and sources of environmental monitoring data. A conference involving users and data providing agencies could be organized to identify concrete ways to proceed.

- Environmental monitoring information dissemination pilot studies should be initiated to draw on the lessons learned from federal, state, and local experience. These studies could draw upon existing information directories and other documented sources.

- A workshop should be planned to bring together the regulatory agencies, the data providing agencies, and the regulated community to determine how they can work collaboratively to use the environmental monitoring information resources already being funded and disseminated by the federal government, but which to great degree are not now acceptable for use by municipalities and industry to meet regulatory requirements.

- Federal agencies should be required to provide appropriate R&D and maintenance of global environmental data that is critical to sustainable development.

Facilitation Team

Jim Ball, National Technology Transfer Center (Session Rapporteur)
Patrick Crowley, Department of Energy (Discussion Leader)
Susan Curley, National Aeronautics and Space Administration (NASA) (Discussion Rapporteur)
Jerry Garegnani, NASA (Session Planning)
Linda Moodie, National Oceanic and Atmospheric Administration (NOAA), Department of Commerce (Discussion Rapporteur)
Michael Scott, National Biological Survey (Discussion Leader)

Greg Williams, NASA (Discussion Rapporteur)
Greg Withee, NOAA (Discussion Leader)

Breakout Session 9
Environmental Education and Training

Co-Chairs: **J. Tom Pyke, Director of the Global Learning and Observations to Benefit the Environment (GLOBE) Program, National Oceanic and Atmospheric Administration (NOAA), Department of Commerce (DOC)**
David Boon, Front Range Community College, Colorado

Panelists: **Maggie Goud Collins, NOAA, DOC**
Mark Pine, National Aeronautics and Space Administration (NASA)
Michael Saunders, Georgia Institute of Technology
Keith Wheeler, Executive Director, GREEN

Breakout Background

Education provides the opportunity to spur the United States and the global community to higher levels of sustainability. While it is recognized that many initiatives are on-going and have been successful, there is no comprehensive approach to environmental education. The first part of the session provided a framework for the common vision and summarized the results of a recent national forum addressing environmental education. The second part of the session was designed to solicit direct input from participants.

Summary of Key Issues and Suggested Actions

- There is a need for an integrated, interdisciplinary approach to environmental education for students at all levels of education.
- Environmental education programs need to be integrated with other community goals such as training youth at risk, fostering environmental justice, or retraining displaced workers.
- Advances in information technologies need to be applied to environmental education.
- The federal government is the principal supplier of financial support for environmental education, but there is a crucial deficiency in dissemination and coordination efforts. Coordination efforts could be improved by forming a joint Subcommittee on Environmental Education within the National Science and Technology Council (NSTC). The new subcommittee would be a link between the NSTC's Committee on Environment and Natural Resources (CENR) and its Committee on Education and Training (CET).
- Federal laboratories could provide additional educational resources.
- Coordination of effort within every sector is a critical need.
- Innovative environmental educational programs, regardless of the kudos they receive, are too often canceled before they can become self-sustaining. Methods are needed to provide sufficient support until such programs can be widely adopted.

- Teacher training programs are needed at every level to keep up with changes in environmental technology and to fully utilize rapidly expanding data networks.

- Industry representatives expressed the need for environmental education professionals who can adequately serve as integrators of environmental technology, stretching beyond the traditional disciplinary boundaries.

Session Presentations

Tom Pyke, GLOBE, opened the session with a presentation on "Government's Role in Environmental Technology Education." He said that the subject of environmental education and training is very important nationally and internationally. Environmental awareness within the community sets the stage for skills that need to be taught and learned. We need a mix of skills to provide the intellectual foundation to address the environmental and economic issues facing society. We need solid education and training from the lowest grade levels all the way through to domestic and international post-secondary education. We must look forward; anticipate; and work on pollution prevention rather than remediation. The federal role in policymaking and coordinating alternative ways of doing business will help in education and training. Partnerships and small business training and assistance, underscored Pyke, are key things that the federal government can help to provide.

David Boon, Professor, Front Range Community College, made a presentation on the "Role of Education in Environmental Technology." He noted that the audience for environmental technical education includes a broad range of people. K–12 institutions; adult students; educators; employees in business and industry; and state, local, and federal government employees all benefit from environmental training and education. We must focus beyond single impacts and try to expand job opportunities for all. We also need to retrain the dislocated/unemployed workforce. He mentioned that the "Youth at Risk" program in Denver, Colorado, helps to reduce teenage crime by finding jobs opportunities in the environmental industry. There needs to be more hands-on instruction. Workers need retraining as new technologies are applied. He also mentioned that there are "Fast Track" training opportunities, e.g., at Rocky Flats.

Keith Wheeler, Executive Director of GREEN, then made a presentation entitled, "Presidio Summary: Partnerships Supporting Education about the Environment." Wheeler reported that a national forum that examined environmental education partnerships was convened on September 28, 1994, at the Presidio in San Francisco, California. This Technology for a Sustainable Future (TSF) workshop opened a dialogue in order to articulate a shared vision for environmental education. Participants defined partnership opportunities and discussed ways to effectively implement them. The goal is to achieve long-term sustainability of exemplary programs.

Attaining a technology for a sustainable future can be greatly enhanced through environmental education. Citizen access to information must be improved and multicultural education linkages must be formed in university and other education programs. Also needed are international linkages for sustainable human development. The media can also help by promoting a sustainability ethic. Additionally, there is a large need to identify existing networks and try to achieve federal agency sustainability by coordinating resources among diverse stakeholders. The Presidio forum, stressed Wheeler, highlighted the need for everyone involved in environmental education to integrate and craft policies so that everyone speaks with one voice.

Discussion Summary

Following the introductory presentations, the breakout session then examined three issues: (1) ways to broaden the sustainable development education agenda to incorporate technology, (2) the appropriate federal role in environmental education and training, and (3) gaps and needs regarding sustainability issues and educational technology.

Each issue was treated in a presentation to all breakout session participants, and then examined simultaneously by three sub-groups.

Issue 1 - Broadening the Education Agenda to Incorporate Technology

Maggie Goud Collins of NOAA introduced the first issue, stressing the need to see technology as part of the solution rather than as the enemy. There needs to be environmental education directed at the general public, and a move from remediation training to pollution prevention training.

Collins said that monitoring, modeling, metrics, hardware, and software all need to fit together within a systems approach. Managers, lawyers, scientists and engineers must be trained to work together in order to design systems that meet compliance objectives.

The sub-groups identified exemplary models of domestic university and college programs at Ball State University, Columbia University, Duquesne University, Georgia Tech, Tufts University, the University of California (California Water Program), and the University of Oregon. Other college-level programs cited include land grant universities, community college linkages, and university agricultural extension programs.

A foreign model for environmental education and training is Copernicus, a European program that coordinates higher technology education.

The sub-groups briefly discussed the following programs: Partnership for Environmental Technology Education (PETE), GLOBE, Job Corps, School to Work Program, National Service Program, Small Business Development Centers, and Manufacturing Technical Centers of the Department of Commerce's National Institute for Standards and Technology.

Issue 2 - The Appropriate Federal Role in Environmental Education and Training

Mark Pine of NASA introduced this issue, emphasizing the need to clarify how the federal government can encourage the infusion of technology in formal and public education. Pine noted that NASA's Mission to Planet Earth program is looking for a comprehensive education strategy. There are high expectations, but the funding curve is flat.

Pine is intrigued that the shifting paradigms have no federal involvement except for money. The federal government needs input to determine its appropriate role, noted Pine. The federal government's role as a coordinator is widely supported, but when managing individual programs should it be an initiator only or a sustainer too? And should it sustain programs which are initiated by others?

A challenge is ascertaining the role of interactive computer programs and the Internet.

Educators say that we will leave half of the population behind if we immediately implement these computer and communications technologies. The nation may end up with a two-track education system with high tech on one track, and traditional paper, textbooks, posters, and fact sheets on the other. It seems illogical to proceed in this manner. We need an approach that is equitable for all, stressed Pine.

The three sub-groups generated the following list of ways that the federal government can encourage the infusion of technology in formal and public education:

- Provide seed grants for innovation.
- Continue long-standing university support.
- Have government fund key aspects of the Information Superhighway.
- Coordinate and centralize environment-related job rotations among industry, federal agencies, and educational institutions.
- Remove or reduce barriers such as the Federal Advisory Committee Act (FACA).
- Promote and facilitate Cooperative Research and Development Agreements (CRADAs) and other partnership vehicles.
- Support high risk R&D.
- Support high risk educational programs.
- Identify future job opportunities in order to design appropriate curricula (the challenge is to train for jobs that do not exist yet).
- Educate the educators on new technologies.
- Develop foreign relationships and identify opportunities.

Issue 3 - Gaps and Needs Regarding Sustainability Issues and Educational Technology

In his overview remarks, **Michael Saunders** of Georgia Tech said that environmental issues need to be included as an integral part of product development, process design, and manufacturing processes. The Environmentally Conscious Manufacturing initiative at Georgia Tech tries to infuse environmental issues into the education process.

For example, issues of sustainability were addressed in a case study done to solve Kodak camera problems. Masters and Ph.D. level students used an integrated approach in solving these problems. This type of integrated approach could be done by undergraduate students as well.

Saunders referenced the "shooting star" phenomenon wherein a multitude of programs are initially supported, but are not sustained. These shooting stars come and go and there is no continuity. Instead, there need to be long-term programs with clear goals and objectives, to which resources can be efficiently and effectively allocated. Georgia Tech also operates the Georgia Environmental Technology Consortium (GETC) with the state of Georgia. This consortium focuses on economic

development and integrates university faculty with members of local, regional, and foreign industries. There currently are $25 million dollars in GETC investments.

Some of the existing educational gaps and needs include: industry-university linkages; integration of environmental issues faced by industry, policymakers, and educators; and long-term sustained programs to enhance education programs. The three sub-groups then brainstormed and developed the following list of required actions:

- Utilize national laboratories as sites for partnership activities.
- Train industry to have more interdisciplinary training and education.
- Retrain existing workers in environmental awareness.
- Employ more "real world" or "hands-on" approaches in education and training.
- Develop flexible curricula.
- Utilize volunteers fully and effectively.
- Train the trainers.
- Ensure that all technically trained people have an appreciation of environmental issues.
- Improve the reward structure for scientists.
- Reward successful research.
- Address the general public.
- Listen more at the grass roots level.
- Undertake strategic thinking about sustainability.

It was also suggested that a Joint Subcommittee on Environmental Education of the NSTC, made up of members from the CENR and the CET, could be formed to help develop and coordinate national environmental education and training policies.

Breakout session participants agreed that the agenda for this breakout session was an ambitious one, leaving limited time for elaboration on issues discussed. A consensus view was that a future TSF workshop could be very useful in promoting further discussion on the issues and evaluation of individual programs.

It is widely recognized that many initiatives are on-going and have been successful, yet there is no comprehensive approach.

The participants expressed the hope that education-related workshops, breakout sessions, and roundtables will lead to a comprehensive approach to environmental education and training within the National Environmental Technology Strategy.

Facilitation Team

Maggie Goud Collins, National Oceanic and Atmospheric Administration, Department of Commerce (Session Planning)
Sharon Hashimoto, Waste Policy Institute (Rapporteur)
Carole Wacey, Department of Education (Session Planning)
Ken Wright, U.S. Environmental Protection Agency (Facilitator)

Breakout Session 10
Partnerships for Sustainable Communities

Co-Chairs: **George Latimer, Director, Special Actions Office, Department of Housing and Urban Development (HUD)**
James M. DeFrancia, Board Member, Urban Land Institute, and President, Lowe Enterprises Mid Atlantic

Panelists: **John Bullard, Director, Office of Sustainable Development and Intergovernmental Affairs, Department of Commerce (DOC)**
Andrew Euston, Leader for Sustainable Community Development Explorations, HUD
Nancy O'Brien, Director, Thomas Jefferson Planning District Commission, Charlottesville, Virginia
Robert Olson, Associate, Institute for Alternative Futures
Jorge Vanegas, Associate Director, Center for Sustainable Technology, Georgia Institute of Technology

Breakout Background

This group's focus was on urbanization, technology and the "sustainable community development marketplace." This market provides industry with its greatest sustainable technology opportunities. The U.S. population is urban—about 90 percent metropolitan-based. In contrast, world population is 50 percent metropolitan. Urbanization is American industry's largest aggregated market, and the building of sustainable communities is becoming technology's largest single market.

It is probable that, as global population doubles in an estimated three decades, urbanization as a market for technology will quadruple or more. Partnerships of many kinds will be required to build and rebuild the communities of today to remain sustainable tomorrow. The key task for these partnerships will be advancing the global market for urban technology in general and for ecologically balanced urban technology in particular. Combined, these technologies comprise the new sustainable community development marketplace, a concept currently being introduced by the many localities participating in HUD/U.S. Department of Agriculture (USDA) Empowerment Zone-Enterprise Communities. Ultimately this market will mean hundreds of billions of dollars annually in local investments built on thousands of partnerships. The speed with which technology converts to sustainable communities will go far to affect the well-being of civilization as a whole.

Summary of Key Issues and Suggested Actions

Government was viewed throughout this breakout session as a critical partner through its policies as well as through its funding of the sustainable community development marketplace. Industry, commerce, and academia were seen as drivers of the technical problem-solving component of this new market. Corporate and foundation grants were seen as pivotal resource elements if there is to be a timely evolution at community levels of a partnership-based sustainable community development marketplace. Session participants highlighted the critical importance of capacity-building and communications for and within the urbanized community-customer sector. The citizens' aggregated choices will largely determine the design, direction and outcome of our civilization's future.

- **Industry** can induce greater economic progress in America by collaborating directly with communities that can identify their priorities for the future, especially where that future is envisioned to be a sustainable one. Such communities are ready-made innovative laboratories for entering the largest world market, that of urbanization. They can be found in every region of the United States. Industries seeking to become competitive in this market need to initiate their own cooperative ventures that directly engage local communities in a two-way process.

- **Communities** that focus on their capacity to balance their social, economic, and environmental concerns have the most promise for shaping their own future. They can draw to them entrepreneurship while promoting stewardship. They can raise the sights of their young, improve the quality of living, and pave the way for future generations' well-being. Such places generally have to begin by taking their own first steps and by seeking out lessons and clues from the successes of other places with similarities.

- **Government** at all levels has the potential for inducing dynamic changes even through modest steps. The power of cooperation and partnership is well enough appreciated. What is needed are the new outlooks and experimentation that can substitute police powers for creative options in the complex arenas of sustainable community development.

- **Corporate and foundation** grants people have a new stewardship role: supporting the advancement of local community sustainability efforts. Required by many communities are tools, training, facilitation, and concepts to allow them to harness and contribute their energies to these concerns and opportunities.

- **All parties** have a mutual need to encourage communities at every scale (neighborhoods to metro-regions) to understand and address their own interests at the sustainability table. Places vary widely in their readiness and capacity to take part. Empowering communities to do so involves training, communications, and assistance so as to bring voters, future voters, and their contributions to the table. As new and refocused clearinghouses, electronic software tools, public networking media, and other potential resources become available, all communities deserve free access to maximize their roles as participants. All parties have an interest in helping to speed things along.

Session Presentations

Co-Chair **George Latimer** of HUD commented on a new U.S. partnership venue, the concept of "sustainable community development," and on the associated program which was introduced by Vice President Gore, the new Empowerment Zone-Enterprise Community Program of HUD, USDA, and other federal agencies. This and other programs were discussed that identified technological market links between urbanization and ecology. Speaking for industry, Co-Chair **James DeFrancia** cited the sustainable communities idea as central to the work of his development colleagues at the Urban Land Institute.

Lead-off panelist **John Bullard** of DOC emphasized the economic bottom line importance of sustainability. He cited as an example New Bedford, Massachusetts (where he served as mayor), that recently lost its fishing industry due to unsustainable practices in recent decades. HUD's **Andrew Euston** emphasized the centrality to our urban-industrial civilization's future of focusing on both urbanization and ecology. **Nancy O'Brien**, another former mayor and a multi-county planning

director, told of the national pilot community partnership she conducts in rural Virginia to examine the economics of environmental protection there.

Futurist **Robert Olson** identified community development as the major market for industrial production. **Jorge Vanegas** of Georgia Tech's Center for Sustainable Technology was emphatic that the choice-making of citizens is crucial to the promotion of sustainability. They must be included in decisions; they have vital contributions to make; and their ability to play a full partnership role demands capacity-building help, quality information, and facilitation from the sectors that are empowered to do the ultimate urban investment decision making.

Following these introductory speakers, three sub-group topics were then explored: the market, the community-consumer, and public policy. The emphasis was on local industry-community-government partnership initiatives that foster sustainable communities, i.e., local partnerships for integrating the combined social, economic and ecological rebalancing of urbanization.

Discussion Summary

The discussions, which included breaking into sub-groups, were based on the premise that **sustainable community development** "involves guiding the social, economic and ecological rebalancing of urbanization within the dictates of natural ecology. The processes involved must assure that future generations will have the resources they need for securing a satisfying life." Following are selected comments by participants.

Steve Smith of Denver's Landmark Reclamation, Inc., said that his firm develops environmental technology by bidding on routine city and state contracts with the intent of using the work to offset R&D expenses. He agrees in advance to use "green technology" and to show the customer how a specific component works. If business were offered a "reuse credit" (e.g., for waste water), hundreds of gallons could be saved. Communities with the right water treatment facilities and the right initiative can create revenues by providing for cooling and other industrial uses.

Mary Tucker, an environmental policy director from San Jose, California, noted the very delicate ecological problems at their end of the San Francisco Bay where the water is very shallow and where there is a very high degree of urbanization. In addressing this situation, Silicon Valley's business community is becoming increasingly proactive about partnerships that benefit the taxpayer, the tax base, and the quality of San Jose's environment.

Olin Ivey of the Georgia Environmental Organization said his group works with the state's private utilities, with firms, and with lower income communities to create jobs and remedy environmental injustices. They could do much more good with modest, but flexible, funding.

Jeff Bercuvitz of Vermont's Community Innovation said that those who are busy promoting partnering between industry and communities have to straddle between two perspectives surrounding the economic "externalities" of technology products and services: people in business and investment who want government paying for them up front, and people who say environmental rebalancing cannot be real until prices are made to reflect costs that are real. In the meantime, if society must in the end bear the costs, the challenge for community sustainability partnerships is to prevent damage and create value at the same time.

Americorps' **Meg Maguire** declared that these issues are absolutely central to jobs and the economy. It is vital that those in the federal government get their act together helping communities with local sustainability. One thing that could help is for HUD, the Department of Health and Human Services, and the Department of Transportation to begin to take a similar high degree of interest in sustainability as have the Departments of Agriculture, Commerce, Energy, Interior, and the U.S. Environmental Protection Agency. HUD is not prominently involved with the President's Council on Sustainable Development. The DOE is not represented on the Vice President's Empowerment Board. Such disconnects could be very easily remedied even on an informal basis. Perhaps Americorps could be a catalyst.

Participants provided comments about barriers:

- Bringing innovative technology to a city can be difficult, which is why it is important for communities to be encouraged to form partnerships that open options up to public understanding and consensus.

- The federal government lacks flexibility in the matter of regulations: "One size does not fit all." Local communities are often at loggerheads with the federal government.

- Some move away from federal control is necessary. Government often gets in the way of creative solutions.

- Local governments may also obstruct sustainable development, e.g., because the issues are made obscure, or because citizens often lack the option of sitting at the decision table.

- Community development is a local/regional activity. One important barrier to sustainable development is poor intergovernmental relations. Another is lack of funds.

Participants also provided ideas on options and remedies:

- Ordinary citizens increasingly are understanding the issues relating to sustainable community development, and are willing to contribute to their community's vision and to get behind the necessary planning and partnering.

- Communities are not just economic entities; they are social, cultural, and spiritual ones. All these aspects must be treated. Technological decisions have often been removed from social reality. Today's technological decisions need to be technical-social decisions.

- Urban sprawl is a result of choices made by society. It has produced severe traffic problems, air and water pollution, loss of open space, loss of biodiversity, energy waste, and other major inefficiencies. These problems can be solved by innovative technology, but only in part. The patterns of community development must also change. Communities must work toward efficient land use patterns that reduce congestion and promote convenience, safety and sociability.

- As in the case of the Georgia Tech's Center for Sustainable Development, we must put the soul back into technological development. To do this an interdisciplinary, systems approach is needed, allowing for an interactive relationship with the communities that will be affected. The education of scientists and engineers, urban professionals and technocrats needs to go beyond one part of a system to encompass greater understanding of the whole.

- Land is ultimately a community asset under the temporary control of a private or sometimes public "owner."

- Our choice is not "jobs versus environment." Both concerns must be blended together. For example, in New Bedford, Massachusetts, the fisheries have become massively depleted by over-exploitation and so the community is suffering economically. The lesson? If one destroys an environmental resource one destroys a base for jobs.

- Federal and state governments should encourage local investments in community sustainability. How well they plan, design, equip, and refit communities will condition not only how socially and ecologically sustainable they become--but also how socially viable and economically competitive they become.

- Industry and communities can pave the way for innovations, retrofits, and breakthroughs in sustainability technology through the aggregating of purchases.

The discussions highlighted that urbanization, with both physical aspects and related economic development, is a massive technological system with innumerable technological subsystems. These include infrastructures, electronics, food and fiber production, energy production and distribution, transport, consumer goods, etc. Urbanization is industry's largest aggregate market system, its largest competitive market, and its largest means of having an impact on the environment. Hence, it also is industry's largest target of opportunity for the balancing of both economic growth and environmental sustainability. Sustainability means much more than the fine-tuning of the status quo. It includes dealing with efficiency, limits in resources, impacts of toxic substances, absorption of productive land, social issues, and capacity for change.

Case Summaries

This breakout session included the presentation of a number of case summaries dealing with, respectively: (1) marketplace, (2) community, and (3) government. The cases summarized below illustrate the diversity of partnerships and actions needed to advance the sustainable community development marketplace.

Marketplace Cases: Sustainable Community Development Infrastructures

Sustainable community development will work only if local infrastructures are fully sustainable. These infrastructures are undergoing increasing technological change. Traditionally, we have seen infrastructure as large public and private works, as systems and networks such as roads and rails, reservoirs and power plants. Today we must expand the definition of "infrastructure" to include the basic systems that allow modern civilization to operate. From this perspective, we consider not just the physical networks but other systems as well: natural ecological systems (aquifers, urban forests); physical network systems (transport, utilities); physical in-fill systems (homes, industry, parks); communications systems (tele-marketing, tele-commuting); regional resource systems (lakes, farms, forests); and global resource systems (air, water, ores, fibers).

This framework offers a way to help us understand why market changes are occurring in the technologies of urbanization. One challenge for industry in becoming more competitive within these markets is to address multiple clients, multiple performance specifications, multiple legal

requirements, and a diversity of cultures. The dynamic role for partnerships that can successfully bridge these complex market variables is illustrated by two cases:

- **Case: Personal Rapid Transit (PRT) Innovation.** Chicago's partnership for very light rail elevated rapid mass transit, formed in 1993, will test this technology for use in Rosemont, Illinois. The Chicago Regional Transit Authority and the Raytheon Company are investing $40 million, using key patents owned by the University of Minnesota and developed by the Taxi 2000 Corporation of Massachusetts. Rosemont's civic and government leaders have prepared the way with a plan for such a system. When operational, this energy-saving PRT system will provide travel at a small fraction of the cost of subway-transit technology for comparable ridership volumes. This U.S. technology is one of the first to offer a potential cost-effective challenge to private U.S. auto dependency.

- **Case: Technology for Solar Aquatic Water Treatment.** Ecological Engineering, Inc., and such clients as the City of Providence and PAWS, Inc. of Muncie, Indiana, have embarked upon several three- to five-year pilot projects to introduce highly efficient greenhouse-based, biomass producing, natural water treatment facilities that use far less energy and equipment, and rely instead upon living organisms and plants to purify the polluted effluent streams of raw sewage. The potential market for such systems is in the billions annually.

Community Cases: Mobilizing Sustainability Through Partnerships

Partnership formation is the primary precondition for the growth in the United States of an industry for sustainable communities. Partnership formation is also the primary precondition for the growth of a critical mass of markets to advance and support innovative and competitive sustainable U.S. products and services. If government's basic role (at all levels) is one of proactive encouragement, and industry's basic role is to innovate, it is the community sector's role to mobilize political and investment decision making in the direction of sustainability. Communities can generate a market, set standards for performance, and help level the investment playing field.

Learning how to establish partnerships on a "bottom-up" basis is one aspect of the community-level role. Another aspect is how to attract investment partnerships with support from either government or the private sector or both. All these possibilities call for readiness and initiative locally. This means the ability to weigh in, to understand complex choices, and to pull community interests together in the same direction. The importance here for industry and for technology is that the more America's communities get their own sustainability acts together, the more that a critical mass of markets will advance to support innovative, competitive and exportable products and services. Three cases are illustrative:

- **Case: Mini-Grant Projects of Chattanooga, Tennessee.** Like a growing list of places this locality has experienced the award of city and county grants for small-scale neighborhood improvement. The grants address social, economic, and environmental concerns using often minimum grants of $250. Grants are awarded with the expectations by the grantors that the grantees will show up at intervals to tell people what they did, why, and how. If the grantees do not do so, their entire neighborhood gets no grants the next round. Results have included local industries linking up with neighborhood church groups and businesses to recycle, to cut pollution and waste, and to seek out cost-effective technologies (such as one for removing stream-bed toxins from a popular urban swimming hole).

- **Case: Community Treasures Initiative of Issaquah, Washington.** The Pomegranate Center for Community Innovation, backed by 23 civic groups, identified hundreds of local "treasures" (natural, cultural, historic, etc.). During 1992–93, the initiative involved 50,000 citizens and $20,000 for consultant managers. The treasures were mapped, strategies for preservation and enhancement were set in place, and key agendas were promoted via elected officials, businesses, and local private institutions.

- **Case: Sunshares, Inc., Centers, of Durham, North Carolina.** Seventeen new for-profit recycling centers were created involving 1,000 lower-income neighborhood block coordinators, 150 businesses, and 24,000 households. In three years these centers went from processing 60 tons to 480 tons of waste stream per year. The centers employ 29 ethnically diverse local citizens, and generate a long list of by-product business development opportunities in the broader community.

Government Cases: Sustainable Community Development Market Collaborations

Many of the things government can do to promote sustainable community development partnerships involve a shift from police power emphasis to positive, creative, and integrative collaboration. This theme was resounding during the White House Conference on Environmental Technology, and it is central to environmental technology's emergence as a world market. The customary technology transfer function is another role that traditionally top-down government agencies must expand in helping U.S. industry to build a competitive urban market base. Another action area for government aiding local capacity-building efforts through such means as user-friendly communications that serve groups as well as individual users.

The partnership aspect of federal government has long been funding-based. Requirements for positive government actions, not just funding, are being exacerbated by such phenomena as the deferred maintenance bill coming due throughout the United States for aging public infrastructures; increasing storm, earthquake and flooding damage, with the resultant downsizings of coverage by private insurers; increasingly expensive automobiles; military base closings; industrial job exporting and downsizing; mounting environmental, health, and social injustice costs; and, in general, the continuing consequences of society's deferral of "true cost" pricing of the effects of civilization's behavior with regard to urban and industrial activities. As such numerous pressures build and mix together, industry is being boxed in by them; local communities are compelled to become more intelligent consumers and investors; and government at federal and state levels is being reshaped accordingly. With government's help it is in this climate of pressures, costs, and changes that communities and industries must seek out practical partnership bridges for their mutual benefit. Two cases provide insights:

- **Case: Intermodal Surface Transportation Efficiency Act (ISTEA).** The Department of Transportation (DOT) has invoked a planning process that could profoundly affect federal road investments or their alternatives. DOT calls for relating all urban infrastructure conditions of an area to its transportation facility decisions before funding them. This has significant implications for technology partnership-building well beyond transportation. An example is the "Building Alliances to Restore Coastal Environments" portion of the President's Coastal America Initiative. This process links up the Federal Highway Administration, all levels of environmental protection agencies, the Departments of Defense and Interior, as well as other local infrastructure network organizations (utilities, water and sewer, parks and recreation, etc.). The goal, to revitalize America's coastal ecology, involves technologies and organizations engaged in agriculture, boating, fisheries, water and land transport, communications, and community

development. ISTEA, while tied into this process, is itself generating similarly diverse partnerships within each metropolitan area that chooses to build new federal highways.

- **Case: The West Coast's Sustainable City Project.** In 1986, three cities (San Jose, San Francisco, and Portland), along with the Washington State Energy Office began with HUD and DOE encouragement to formulate the earliest generic technology menus for urban energy efficiency. The effort already guides many hundred millions of dollars in public and private investments locally. For example, Portland's Criterion, Inc., is performing the Sustainable City Project's work with additional help from state and federal agencies, local city and county jurisdictions, and private developers. The result is PLACE^{3}S, "PLAnning for Community Energy, Environmental, and Economic Sustainability," a software tool and methodology for designing and pricing that, for the first time for local communities, combines geographic information systems, census, economic input/output, and other local data to project detailed costs and consequences of infrastructure alternatives. This tool will bring thousands of "smart" city, county, and metropolitan communities squarely into the sustainable infrastructures technology marketplace within this decade.

Facilitation Team

William Becker, Department of Energy (Assistant Facilitator)
Richard Bradley, International Downtown Association (Facilitator)
Andrew Euston, Department of Housing and Urban Development (Session Planning/Rapporteur)
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Breakout Session 11
Infrastructure for Building Technologies

Co-Chairs: **Harvey Bernstein, President, Civil Engineering Research Foundation (CERF)**
Arthur Rosenfeld, Consultant to the Assistant Secretary for Energy Efficiency and Renewable Energy, Department of Energy (DOE)

Panelists: **Richard Wright, National Institute for Standards and Technology (NIST), Department of Commerce**
Kathleen Almand, CERF
Carl Magnell, CERF
Joe Romm, DOE
Delon Hampton, architectural engineer

Breakout Background

The objective of this session was to explore the barriers and challenges facing the building industry in designing, maintaining, and retrofitting buildings and furnishings for sustainability. Participants expressed the consensus view that the magnitude of the industry is not appreciated. Construction is the largest manufacturing sector in the United States, comprising 13 percent of GNP. The importance of the built environment is further underscored by the fact that most Americans spend 90 percent or more of their time indoors. Thus, the design and construction industry is vital to environmental sustainability and productivity. Public policy, therefore, should support quality and environmental sustainability in constructed facilities. Overcoming barriers to the use of sustainable technologies and processes and meeting the challenges regarding sustainable buildings are difficult due to the fragmentation of the construction industry, which comprises over one million firms. This fragmentation increases (1) the difficulty of maintaining a well-focused R&D effort, (2) the difficulty of technology transfer, and (3) the difficulty of standardization and communication.

Summary of Key Issues and Suggested Actions

- Building occupant productivity increases of 10–15 percent are deemed possible utilizing existing building design and construction technologies. This can often be accomplished without a substantial increase in new building cost. Breakout session participants would like to see greater consideration of total life cycle costs in the design and building of a constructed facility, e.g., basing financing on the life cycle cost, not the initial cost of a building.

- In the R&D arena, the lack of government leadership in promoting and supporting technology demonstrations and in utilizing advanced technologies are barriers.

- The lack of confidentiality surrounding the submission of unsolicited proposals to the federal government makes industry cautious in suggesting new approaches and products to the government.

- The use of Cooperative Research and Development Agreements (CRADAs) between the federal sector and the construction industry should be encouraged and expanded.

- In terms of barriers to market stimulation, the lack of incentives for innovation is a major disincentive to builders to provide the new products and services. The consuming public is not actively seeking out these products and services, the provision of which adds to builder costs. In addition, liability concerns often stifle innovation. Without a reliable market, there is little incentive for the design and construction industry to utilize sustainable technologies and processes. The use of performance standards should be encouraged and accepted in the building industry to spur product and service innovation. Market stimulation would be increased by the availability of low-risk technology test beds for technology developers and construction entrepreneurs. Standards must also be developed or in some cases continue to be developed for "greenness" and life cycle analyses.

- There is a significant role for education and training to incorporate sustainability in the construction industry. Education of the construction industry workforce in the use and application of sustainable technologies and products requires labor-management cooperation. Education of owners, designers, builders, and trades people is necessary to instill the practice of using sustainable practices and products. Consumers (facility owners) need to be educated to develop an appreciation of both quality and sustainability in constructed facilities and to stimulate the demand for sustainable buildings. Training of federal procurement personnel should take place to develop appreciation of life cycle performance and value engineering in the acquisition of goods and services.

- In terms of regulatory policy, one stop regulatory approval and tort reform would remove significant barriers to the use of (and risks associated with) innovative technologies and products. Where possible, incentives should be employed instead of regulation.

- A performance-based compensation system for designers and builders could be created whereby all or partial compensation would be pegged to the building exceeding commonly accepted standards pertaining to sustainability (e.g., energy efficiency goals or indoor air guidelines). Another possibility is requiring that bidders on construction projects spend a certain percentage of their sales on sustainability R&D.

Session Presentations

Co-Chair **Harvey Bernstein** of the Civil Engineering Research Foundation (CERF) highlighted that construction is the largest manufacturing sector in the United States, accounting for approximately 13 percent of Gross National Product (GNP); eight percent is attributable to new construction and five percent to retrofitting. It is a highly fragmented industry with over one million firms that rely closely on public-private interrelationships. He stressed the importance of recognizing the huge impact the design and construction industry has on everyday lives.

The fragmentation of this industry is partly responsible for its lagging behind other industrial sectors in terms of productivity gains and resources devoted to R&D. Most design and construction businesses are too small to conduct R&D. Nationwide the industrial sector spends 3.7 percent of sales on average for R&D. However, the design and construction industry spends less than 0.5 percent. This is significant in terms of providing the R&D necessary to develop sustainable technologies and products. Bernstein said that the environment and sustainable technologies are an integral part of the industry's future, and require new ways of thinking. He spoke of the need to overcome barriers to the development of innovative technologies and the need for partnerships to move innovation to the marketplace. He asked session participants to share insights and suggestions

for construction industry goals, policies, and technologies that will beneficially impact the environment and sustainable development.

Richard Wright of the Department of Commerce's National Institute for Standards and Technology (NIST) briefed participants on the National Science and Technology Council's Committee on Civilian Industrial Technologies (CCIT) and its Subcommittee on Construction and Building. The subcommittee is working to: (1) set national priorities, (2) coordinate federal R&D to avoid agency duplication, (3) involve the private sector, (4) identify R&D needs of industry, and (5) monitor foreign technological advances. The subcommittee activities are meant to enhance competitiveness of U.S. industries through sustainable development and life cycle analysis. Execution of the subcommittee's goals would result in high quality construction of facilities, sustainable use of resources for that construction, and a reduction in the impact of natural and man-made hazards on the built environment. Tentative goals for the design and construction industry that the Subcommittee on Construction and Building is considering include: 50 percent reduction in delivery time; 30 percent increase in productivity and comfort; 50 percent less indoor air quality-related sickness; 50 percent less waste generated by construction; 50 percent increase in durability and flexibility of construction; and 50 percent reduction in construction-related illnesses and accidents.

These goals can be addressed by advances in: (1) information and decision technologies, (2) automation and design, (3) high performance materials and components, (4) environmental quality, (5) risk reduction technologies relating to fires and other disasters, (6) performance standards systems, and (7) human factors. Non-technical barriers to reaching these goals include lack of leadership in government and industry, regulatory barriers, liability problems related to innovation, financial disincentives to promote innovation, and adversarial relationships with certain sectors of the public.

Kathleen Almand of CERF stressed that the goals for the industry are quality and efficiency in design and construction, and sustainability. Engineers have an important role to play in promoting sustainability in planning and design, developing sustainable technologies, influencing public policy, influencing client decisions in favor of sustainability, and assessing and reducing the environmental impact of construction operations. Almand stressed that management, design, construction and equipment, materials and systems, and public policy initiatives are necessary to achieve the goals of the National Science and Technology Council (NSTC) with regard to construction and sustainability. The preliminary results of a recent global survey of recognized engineering leaders indicated that none of the aforementioned NSTC goals relating to building quality and productivity would be achieved given the current levels of research, development, and demonstration. However, those surveyed believe the goals relating to environment and energy efficiency were likely to be attained.

CERF's **Carl Magnell** talked about the necessity for most U.S. industrial sectors to be innovative if they are to be competitive both here and abroad. However, he pointed out that innovation in the construction industry is not a prerequisite for survival, and may actually hinder survival. He cited a variety of barriers that act as disincentives to innovation in the building industry, including: risk/liability; financial disincentives; costs; environmental regulations; leadership; initial costs of using innovative products and services; technology transfer obstacles relating to fragmented industry structure; and product development.

Magnell further said that the risks and liability from experimenting with innovative products are significant for builders. Faulty or malfunctioning innovations in homes or buildings would be quite costly to replace. Most design and construction professionals would rather be safe than sorry. Costs

for innovative products and services are high. Many consumers (facility owners) do not appreciate a more expensive product, although it might be built to function better and last much longer. Consumer demand for innovative, sustainable technologies are virtually non-existent. Magnell also noted lax leadership in both government and industry for trying to move this sector forward in terms of sustainability and innovation. Without recognition and demand by consumers for innovation and sustainability in the built environment, meaningful construction sector R&D will lag. Other sectors are more successful in overcoming barriers to R&D. Magnell finished his remarks by reminding participants that the United States cannot afford a design and construction sector that is less than the world leader in innovation and productivity because too much hangs in the balance including environmental quality and sustainable development.

Co-Chair **Art Rosenfeld**, a consultant to DOE, spoke about the need for more uniform and generally accepted definitions for green buildings and sustainable development. He cited the lack of a constituency to influence public policy regarding health issues inside buildings. He reviewed the success of past efforts to make buildings more energy efficient and spoke about future challenges to increasing the energy savings of the built environment.

DOE's **Joe Romm** summarized some recent studies and findings about how indoor air quality, energy efficiency, and lighting can help increase the productivity of occupants rather significantly. He cited several specific companies that have made the investment in better lighting and ventilation and experienced increases in worker productivity and quality. Romm said that pollution and inefficiency are indications of sloppy production. It is far cheaper economically and environmentally to prevent defects and to prevent pollution, than to address these problems after the fact.

Delon Hampton, who heads up his own architectural/engineering firm, called on the industry to take a more proactive approach in creating a political, regulatory, and social environment that is more accepting of design and construction innovation.

Specific Issues and Suggestions

Research and Development

- To address industry fragmentation and the impact on R&D, consider the Swedish system of taxing the design and construction industry one percent to create a dedicated fund for R&D. A stable source of R&D funding would also help industry weather the boom/bust housing cycles.

- Look for unmet needs that cannot be met by normal industry practices, rather than focusing R&D money on basic research. Government and industry must better orchestrate technology to bridge gaps identified by market needs.

- Focus research needs on life cycle analysis for buildings and furnishings. Conduct more in-depth surveys of consumers (building owners and occupants) so that R&D can be focused on the right segments. Innovative ways of conducting research and technology transfer are needed due to industry structure.

- Recognize that external sources of R&D funding may be less important than developing markets and customers for innovative sustainable buildings, technologies, and processes.

- Increase industry use of CRADAs. Stimulate industry interest in vehicles similar to CRADAs by allowing agencies to keep proprietary the contents of unsolicited proposals.

- Enact tax credits at the federal level to entice industries to conduct R&D.

- Consider requiring bidders on federal government design/construction projects to demonstrate that a certain percentage of their revenues are used for R&D practices.

Demonstration

- Increase demonstrations of sustainable products and processes (including those relating to indoor air quality and energy efficiency) for this fragmented industry, and reach out to all sectors—architects, engineers, furnishing manufacturers, zoning officials, and consumers.

- Select locations where sustainable building technology test beds can be created. Use federal sector test beds to help industry meet performance standards.

Regulatory Policy

- Develop a one-stop permitting system that would reduce the cost and time of seeking permits and that would enable the use of performance based, innovative products, processes, and procedures. Create new programs that entice designers and builders to innovate where possible to minimize regulation.

- Institute reforms of the tort system that allow builders and developers to recoup costs from frivolous suits and delay tactics, once proper regulatory approvals and permits are secured.

Market Stimulation

- Create a more stable and reliable market for sustainable buildings. Market demand for buildings and furnishings that incorporate sustainability and life cycle concepts start with educating the consumer (facility owner). Government and industry need to work together to create that market demand. The design and construction sector lacks significant, detailed consumer feedback on products. Industry should conduct a consumer survey and tracking initiative similar to what automakers do. The industry should develop systems to allow consumers to more easily compare and evaluate sustainability and life cycle attributes of the built environment.

- Consider ways to compensate architects, builders, and engineers based on building performance, sustainability, and durability.

- Develop standards for green buildings and life cycle analyses so that the design and construction industry has common targets to shoot for. The standards will enhance consumer understanding, evaluation, and choice.

- Consider and evaluate enhanced federal government programs of building/leasing sustainable buildings and purchasing sustainable products to help create demand for such products and processes.

- Revise federal procurement practices to incorporate life cycle performance. Consider promulgating a federal executive order that allows agencies to consider the present value of future savings from retrofitting buildings for energy efficiency, indoor air quality, etc.

Fiscal Policy

- Consider expanding and enhancing the use of mortgages that take into account quality, life cycle, and sustainability of buildings, similar to mortgage programs that offer better terms for energy efficient homes. In particular such mortgage programs should accommodate the projected higher initial costs of homes built with sustainable technologies.

Partnerships and Collaboration

- Increase efforts among industry, government, and non-government organizations to develop a consensus on standards and definitions of green buildings and sustainable products and processes. The emphasis should be on partnering for quality in construction.

- Develop partnerships that reflect both the positive aspects of the design and construction industry and promote understanding of the economic and social role of the industry in this country.

Education and Training

- Create federal agency fellowships on building sustainability and indoor air quality.

- Educate building owners, designers, engineers, and builders about the benefits of sustainable building technologies and how to use such technologies. Increase labor-management cooperation to increase the quality of constructed facilities.

- Educate consumers (facility owners) regarding the economic and social value of desiring and purchasing buildings built using sustainable processes and products.

- Increase public awareness of the time spent indoors (estimated at 90 percent), and the impact of ventilation, lighting, etc., on occupant productivity, health, and well-being.

Information Dissemination

- Increase the flow of information about sustainable products and processes to facility owners, designers, and builders.

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Breakout Session 12
Transportation Technologies

Co-Chairs: **T.R. Lakshmanan, Director, Bureau of Transportation Statistics, Department of Transportation**
David Albright, Executive Director for the Alliance for Transportation Research

Breakout Background

One of the most significant areas of economic activity which has major impacts on sustainable development is transportation. Although the nation's transportation systems afford most Americans with a standard of mobility greater than that enjoyed by most of the world's citizens, this has come at a considerable cost. The country's dependence on the automobile, in particular, has contributed greatly to a high level of petroleum consumption and greenhouse gas generation, potential deleterious health impacts, poor land use patterns, and significant waste disposal problems. Moreover, the dominant role of the automobile tends to diminish investment in other types of transportation, and has limited access and mobility for those unable to afford private transportation. These issues have led many to argue that the current U.S. approach to transportation is not sustainable.

The operation of the nation's transportation infrastructure imposes considerable environmental costs in a number of areas. For example, internal combustion engines remain a significant, although possibly declining, contributor to air pollution. In addition, there are water and soil quality impacts from the run-off of road salts and petroleum leaks from roadways, fuel spills from ships, and the use of de-icing compounds at airports. Furthermore, activities such as dredging waterways can cause environmental problems, e.g., determining how to treat or dispose of sludge that may be permeated with hazardous materials.

Recent legislation such as the Clean Air Act Amendments, the Americans with Disabilities Act, the Oil Pollution Act, the Intermodal Surface Transportation Efficiency Act (ISTEA), and the Energy Policy Act have formally incorporated the values of environmental quality, social equity, and energy efficiency into the formulation of transportation policies and the operation of the nation's transportation resources. While some call for the development of "sustainable transportation," others suggest the goal should be "transportation as part of a sustainable environment." In any event, transportation must simultaneously seek to balance and achieve important environmental, economic, quality of life, mobility and access, national security, and energy goals for the nation as a whole.

Such concepts as advanced aircraft, electric and hybrid vehicles, Intelligent Transportation Systems (ITS), high-speed, guided ground transportation and other technological innovations hold potential for achieving the goals of "transportation as part of a sustainable environment." In particular, the development of alternately-fueled vehicles holds significant promise, particularly for fleet operators. Unfortunately, the current relatively low price of gasoline discourages much attention to this area. However, the Partnership for a New Generation of Vehicles (PNGV) deserves to be watched closely in the future. This program brings together government and the motor vehicle manufacturing industry in an ambitious program that seeks a three-fold increase in fuel economy and an increase in vehicle recyclability without negatively impacting such other aspects as safety, utility and comfort.

Summary of Key Issues and Suggested Actions

- Transportation solutions are more likely to be successful if they take into account the scale of the problem: local, state, regional, or global.

- Transportation solutions cannot stand alone. They must be part of a balanced approach to sustainable development and include economic viability, social equity, energy efficiency, and environmental quality.

- Transportation is so pervasive that it must be considered to help frame any long-range sustainability initiatives.

Session Presentations

Session Co-Chair **T.R. Lakshmanan**, Department of Transportation (DOT), noted that transportation comprises 12 percent of the Gross Domestic Product (GDP), and is pervasive throughout society. He believes the key issue is how to provide transportation solutions in a way that will promote sustainable development.

Session Co-Chair **David Albright** emphasized that technology is the "bridge" to sustainable transportation and that a full partnership with the public is required to implement the technology. He expressed the national need in three parts: the public well-being, economic vitality, and security.

Following the introductory remarks by the co-chairs, speakers addressed the three issue areas for the breakout session: (1) definitions and dimensions of sustainable transportation, (2) technological opportunities for sustainable transportation, and (3) facilitating a sustainable transportation infrastructure.

Issue 1 - Definitions and Dimensions of Sustainable Transportation

Noah Rifkin, Director of Technical Development, DOT, defined his role as providing long-range prediction. He said that mobility is a public demand that has to be recognized, such as the demand for roads which is unabated. He thinks we must find a way to change our emphasis from roads to a "system" that works better and more efficiently.

Tom Horan, George Mason University, said that he has been working on the definition of "technology for a sustainable future" for years. He is pleased that more policy matters have been brought "under the tent" of the definition. Social issues are clearly a part of the answer. Horan suggested that the term "environmental responsibility" is important in defining what is under consideration here.

Tom Deen, Transportation Research Board, believes that we should not spend an excessive amount of time defining sustainable transportation; rather, he thinks we should work on the issues. He equates sustainable transportation to a sustainable environment in which transportation does not use more than its share of resources. The demand for transportation is here to stay, and any new initiative must balance the desires of the people. Deen said the vehicle industry came reluctantly into the regulatory environment that demanded better bumpers, etc., and believes the industry's credibility now to be low. He spoke of databases capturing the costs of better environmental solutions, and

urged that we not spend excessive time defending the cost estimates. Instead, we should focus on how to interpret the numbers.

Issue 2 - Technological Opportunities for Sustainable Transportation

David Sharma, Director of the Research and Special Projects Administration (RSPA), DOT, enumerated the things RSPA does, including: intermodal safety, hazardous materials management, and intermodal crisis management. Sharma said RSPA works well with DOT's Office of Technology Development. He believes there are many good technical opportunities, e.g., intelligent transportation systems, electric vehicles, and high-speed rail using magnetic levitation. He observed that in FY 1993 more than half of the Defense Department's Advanced Research Projects Agency grants were transportation-related. He believes lightweight materials is a promising area to exploit, and that pipelines should be considered a mode of transportation.

Robert Mull, Ford Motor Company, quoted figures showing that a high percentage of Ford's R&D budget has been environment-related. Mull is involved in the PNGV which has goals of 100,000 mile auto durability, three times current fuel efficiency, and 20–40 percent mass reduction. His experience with other partnerships—concerning the US Car, materials, environment, and vehicle recycling—is that partnering is very important. Leveraging up to 20 times is possible through partnerships. His comment that "electric vehicles are not zero emissions vehicles" elicited some controversy in the breakout session because of the measurable amount of emissions caused by electrical generating plants.

Steve Plotkin, of the congressional Office of Technology Assessment, spoke of the technology being applied to light trucks, higher performance autos, and luxury vehicles. He mentioned that even though advances are being made in technology, applications are not necessarily being made to improve the environment. An example he gave was using super computer designs to make cars stiffer, not lighter; therefore, environmental benefits are not obtained. Since 1987, the engines are more fuel efficient, but the fuel consumption curve has remained flat. Enhanced technology does not seem to be solving the environmental problems. Higher gas taxes do not seem to be politically possible. Plotkin gave two examples of technological improvements companies are making to stay competitive: the steel industry developed stronger steels to attain a ten percent weight reduction and remain competitive with plastics; and the oil company ARCO is developing a new fuel to meet California standards and remain competitive with makers of alternate fuels.

Issue 3 - Facilitating a Sustainable Transportation Infrastructure

Richard John, DOT, introduced representatives at the state and local level who would focus on the infrastructure question.

Frank Dan, State of Georgia, gave evidence that the infrastructure for transportation is not yet completed. His theme was that growth requires multimodal infrastructure improvements in such areas as non-point source pollution, winter salt maintenance, and dredge spoil disposition. Of great concern is the decision-making process concerning land use. Some areas have centralized decision making while others are localized. Noise issues are also involved. Better decision-making processes are needed to alleviate this concern. Another land use problem is demand management: the occupation rate of vehicles is perhaps evidence that the United States is too well off. He acknowledged a Swedish participant's concern that Americans consume one-third of the world's transportation energy.

Philip Shucet, Michael Baker, Jr. Inc., who also is Chair of ITS America, underscored the sharp contrast between the over 1,000 well-dressed conference participants and the millions of other Americans who neither care about this conference nor appreciate that the government can do much to better our society. Shucet believes that there are many technologies "on-the-shelf" looking for a market, and that our leaders need to make more courageous choices.

Discussion Summary

After the presentations on the three issues, the breakout session participants separated into three separate discussion groups. At the sub-group meetings, participants developed the following responses to questions posed to them for discussion.

Issue 1 - Definitions and Dimensions of Sustainable Transportation

What specific concepts must be included in any definition of sustainable transportation?

- Intergenerational responsibilities
- New energy system
- Balance of needs: environmental, economic, and quality of life (mobility, access, etc.)
- Education and leadership to affect a shift from single occupancy thinking
- Proportional shares of resources

How do we balance different aspects of transportation reflected in recent legislation when decisions are made?

- Internalization of true social costs
- Flexible infrastructure system
- Flexible policy framework which feeds into flexible infrastructure
- Performance-based versus prescriptive legislation/regulation
- Many initiatives

What specific information do policymakers need to make appropriate transportation decisions? What do consumers need?

- Precise impacts of alternative decisions
- What is irreversible

How can we best fill these information gaps?

- Modeling and system assessment
- Prototyping and alternatives
- Focusing on the global level of decision making
- Incorporating uncertainties into the information that is provided, and recognizing the realities of the decision-making process

How can decisions having large social impacts be made in the face of major technical uncertainties?

- Doing the work ahead of time, in case of a crisis situation
- Having policies geared to the appropriate scale (i.e., global, national, local)

Issue 2 - Technological Opportunities for Sustainable Transportation

What are the prospects for a successful introduction of alternate fuel motor vehicles in the near future? Which technologies (electric, methanol/ethanol, natural gas, hydrogen, or hybrids) should we emphasize?

- With no significant change in gasoline prices, we have little opportunity to introduce other fuels
- If prices remain unchanged, alternatively-fueled cars are "niche" technologies
- Fleet operators are looking for breakthroughs in fuels for their fleets

Should research/demonstrations on high-speed ground systems (such as the French TGV Bullet trains/magnetic levitation trains) be increased?

- No. Maintain U.S. efforts at about the same level

What are the best approaches to the issue of increasing the recycling of vehicles and their components?

- The auto industry's Big Three now recycle 75 percent of vehicles
- The PNGV initiative has a target recycle rate of 80 percent
- This effort is already happening; therefore, further intervention is unnecessary

How can decisions having large social impacts be made in the face of major technical uncertainties?

- Take into account that with low emission vehicles there will be effects on other issues, e.g., keeping old cars, high-occupancy vehicles, etc.
- A limited amount of the population will risk trying the electric car
- California is looking for cleaner transportation and increased fuel economy (low-emission vehicles only are not enough)
- Mandates are not as effective as partnerships, such as the partnerships between government and industry

Issue 3 - Facilitating a Sustainable Transportation Infrastructure

Do we have adequate planning and analytical tools needed to address these issues?

- The simple answer is no
- The management systems mandated by ISTEA are still being developed
- The planning process does not address land use, which is fragmented among many jurisdictions
- Metropolitan Planning Organizations (MPOs) can plan, but they have no enforcement authority
- Help is needed in making the best investment decisions

What specific methods should we pursue to mitigate the impact of transportation operations on the environment?

- Much work is being done on air quality issues, but there are other environmental impacts that must be included, such as: sludge disposal from dredging waterways; non-point source water runoffs; noise from transit, highway, and airport operations; disposal of used tires, batteries, motor oil (using shredded tires to repave roads); wetlands impacts; de-icing substances; historical/archaeological/social/neighborhood/impacts of building infrastructure; impacts of congestion on businesses; and the need to create a new, nationwide infrastructure support for any new vehicle fuel

How are we currently dividing our efforts between prevention, monitoring, control, or remediation? Is this the proper balance?

- The current situation is that the Environmental Impact Statement (EIS) process lasts only until a new infrastructure is built, and continues only for a few topics (endangered species, wetlands mitigation) for only a few years. Most current efforts are in control/remediation.

- For the future we need to develop improved planning, analytical and congestion management tools and capabilities. We need to place more emphasis on environmental monitoring, especially of operating transportation systems, in a proactive rather than a reactive way (thus problems can be discovered and steps taken before significant environmental damage occurs). We need to use land use policy to enhance prevention and control.

How can the federal government best contribute? State and local government? Private sector?

- The federal level should encourage and support R&D; incentivize appropriate land use policy at the local level (e.g., a sliding scale of matching federal funds); and refine modeling and analytical tools.

- The state and local levels should develop R&D priorities (e.g., water pollution, endangered species, historic preservation, noise)

- The private sector should pay more attention to the public impacts of private decisions

What specific information do policymakers need to make appropriate transportation decisions? What do consumers need?

- The real issue is not a lack of information, rather it is the need to achieve consensus among all included parties
- One information deficit, however, is the need to educate drivers about the real costs of their actions

Facilitation Team

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Breakout Session 13
Transition to Industrial Ecology

Co-Chairs: **Christine Ervin, Assistant Secretary for Energy Efficiency and Renewable Energy, Department of Energy (DOE)**
Brad Allenby, Vice President, AT&T Engineering Research Center

Breakout Background

The United States has the capacity to create an industrial system that emulates natural ecosystems. Ways to do so include the careful selection of raw materials; the design, manufacture, growth or generation of products, processes, and services; and the design and use of residuals. By applying the principles of industrial ecology, society can move towards a sustainable economy that provides food and fiber, shelter, energy services, transportation, and manufactured goods and services more equitably and to a greater number of people, in a manner that does not compromise the integrity of present and future global and regional ecosystems.

Realizing this vision will require an evolutionary change from our current set of linear and fragmented fiscal, regulatory, science, and technology policies to an integrated and shared system of social, economic, and environmental values that reinforce one another. The vision also will require us to move from approaches of command, control, and confrontation to strategies of cooperation, coordination, and trust. The public and private sectors need policies which make everyone partners in a shared set of objectives—not antagonists trying to achieve mutually exclusive objectives.

Summary of Key Issues and Suggested Actions

The federal government should provide the framework, data, and information systems, as well as act in a catalytic and facilitative role, to develop the science and technology base for industrial ecology in partnership with industry and academia. Universities should expand courses on industrial ecology. Industries should implement pathways that combine market attractiveness, environmental protection, and resource efficiency. Other actions were suggested:

- Focus on fundamental and applied R&D to broaden the scientific foundation for future applications of industrial ecology. Address integrated technological systems through data collection, interpretation, and modeling to describe current and future complex infrastructure options through partnerships.

- Coordinate, identify, and fill data gaps; integrate existing databases; and create new databases in standard, accessible format on flows of raw materials, wastes, energy, and water referenced to local, regional, national, and global environmental conditions. Develop analytical and visualization tools for decision makers to assess total life cycle costs of different infrastructure choices.

- Implement and assess the application of industrial ecology principles to selected, specific, and integrated industrial, urban, agricultural, airshed, and watershed demonstration sites. Take into account existing and evolving brokerage functions to match industries, resources, and desired products or functions. Include in the selection criteria economic, social, and environmental

factors such that all aspects of the demonstration can be assessed. Use lessons learned for developing and refining operational practice.

- Provide public education on industrial ecology benefits through showcase demonstration projects in collaboration with industry, academia, and other stakeholders. Recognize that environmental awareness and understanding of science-based risk in our society are key components.

- Establish processes for accelerated inter- and intra-firm collaborative activities to encourage the demonstration and market introduction of technologies for industrial ecology. Establish a structure for identifying and implementing unique innovative systems approaches based on industrial ecology and for identifying and mitigating unnecessary barriers (permitting and others) to environmentally preferable technologies and systems.

- Create flexibility to encourage first use of new technologies and encourage experimentation with new approaches to mitigating the environmental impacts of economic activity. Simplify the demonstration process for new technology, and reduce the different sets of regulations for demonstrations. Have the regulatory systems overall provide flexibility, preserve accountability, and encourage efficiency to increase competitiveness and environmental protection.

- Allow transnational companies to be major players both in the development and deployment of systems and technologies in collaboration with government. Enhance industrial ecology benefits through the participation of local and global associations. Minimize the impact of non-regulatory practices (e.g., antitrust laws, government procurement, consumer protection) to expedite the development of environmentally preferable technologies and facilitate intrasectoral cooperation. Establish standards for environmental literacy.

- Emphasize R&D concerning methodologies and data for products and specific situations all the way up to broad systems. Pursue this direction through government, industry, and academia.

  Product Specific: Study stocks and flows of five materials (water, metals, forestry, plastics, and agriculture) and energy to establish an industrial metabolism portfolio and database to evaluate environmental impact of options and to facilitate decision making.

  Metrics: Provide the same or better quality of life with slower materials cycling and higher materials productivity (more and more product life out of less and less material). Develop industrial ecology metrics to use and assess progress towards goals. Apply these metrics to specific demonstration projects and use metrics' results to define such projects and establish priorities for their selection.

- Evolve from designing widgets to understanding the impact of widgets on systems (social, economic, and environmental). Recognize the importance of understanding the entire environmental technology system, not just individual products and processes.

- Create collaborations and partnerships among government, industry, and academia to implement industrial ecology principles. Promote or offer incentives to remove barriers to partnerships. Increase flexibility of the regulatory system while maintaining accountability to accelerate application of industrial ecology concepts.

Session Presentations

Session Co-Chair **Christine Ervin**, DOE, welcomed the participants. She noted that in the United States, the mile-per-gallon efficiency of passenger cars has increased 39 percent, from 15.5 miles per gallon in 1980 to 21.6 miles per gallon in 1992. However, energy consumption in transportation has increased 14 percent despite the efficiency increases. Furthermore, driving today is cheaper than in 1980. Our sprawling land use pattern and the number of cars each family owns has increased, and so has the number of vehicle-miles traveled (43 percent increase since 1980). Thus, the need is to design the system -- the overall transportation system, in concert with the design of the community, so that the services needed can be provided using resources efficiently and leading to low environmental impact. She emphasized from her experience in Oregon the importance of partnerships between industry and the federal, state, and local governments to implement pollution prevention measures, avoid pollution, and protect the environment. Reducing the environmental impacts of economic activity is essential to achieving sustainable development. Pollution prevention, improving resource efficiency, and designing an integrated system are components of industrial ecology.

Session Co-Chair **Brad Allenby** of AT&T introduced the concept of industrial ecology as "a means by which humanity can deliberately and rationally approach and maintain a desirable carrying capacity, given continued economic, cultural, and technical evolution. It requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them." The transition to industrial ecology was equated to re-engineering of the industrial revolution. It necessarily takes a systems view of design and manufacturing activities so as to reduce or, more desirably, eliminate the environmental impacts of manufacturing processes, technologies and products across their life cycles, including use and disposal.

As the scholar Kenneth Boulding has noted, when the human economy was small relative to the global ecosystem, sources and sinks appeared unlimited. As population and per capita consumption increased, our economy has grown to rival natural systems in scale. As a result, humanity's effects on sources and sinks become a constraint on growth assuming the current path of development. The systems must evolve to be efficient in the use of materials and energy. Understanding these systems, studying the materials and energy flows within, and assessing the impact of these flows on the environment is key to reducing the amount of material (energy) needed to perform a certain function, and material productivity (energy efficiency) is key to minimizing environmental impact and cost. Developing technologies and systems which provide basic human needs such as food, shelter, energy, transportation, and manufactured goods and services while minimizing the material and energy flows and non-usable wastes generated makes good business sense and needs to become an integral part of our design paradigm.

Tom Sciance of DuPont emphasized that the greatest challenge of the next hundred years is balancing economic, environmental, and social needs. The chemical industry is preparing an industry vision and a road map to sustainability. He stated that there is a difference between industrial policy (picking winners and driving industry behavior) and technology policy. The government spends nearly $80 billion per year on R&D, almost as much as the entire private sector combined. With that magnitude of effort involved, the federal government must have a coherent technology policy. Technology policy has been a bipartisan effort for more than a decade. Sustainability and industrial ecology are good technology policy elements and should continue to receive bipartisan support.

Sciance said that the European effort called SUSTECH, which involves cooperative R&D for sustainable technology, should be considered. The list of needs as outlined by SUSTECH are the

same as the list of needs of the U.S. chemical industry. In fact, the players are the same, since most large chemical companies are multinationals. Unfortunately, the rationale of SUSTECH, "to counter the U.S. and Japanese threat," is the same kind of rationale underlying many U.S.-proposed federal-private sector partnerships. The United States needs to work on a global basis in the field of environmental technology to maximize efficiency and eliminate needless duplication of effort.

Sciance emphasized that partnerships are vehicles for promoting sustainability. He recognized that partnerships are not the same as "business deals." They differ in that the benefits to each party are not merely financial, and the contributions of each party may differ significantly. As a result, the role of government, or of industry, should not be merely that of a bank. The barriers which inhibit the creation of effective partnerships should be identified and lowered and the incentives for working together should be clarified. Although additional federal R&D funds are not needed to promote sustainable technology, the existing funds must be focused on these high-priority goals with cooperative efforts by the various agencies. Government must focus partnership efforts with industry closer to the market. Industrial ecology certainly calls for a fundamental effort and the acquisition of new scientific knowledge, but sustainable development calls for technology to be implemented. Sustainability is a long-range problem, and it is necessary to pull technology into the market from the laboratory, taking into account the savings from the full future environmental cost of our actions.

Faye Duchin of New York University reported on a recent feasibility study concluded by her institution relating to the Bruntland report (*Our Common Future*). The study recognizes that bold technological changes are needed to reach the goals of that report. Government has a major role in accelerating the development of necessarily higher risk sustainable technologies. She further emphasized that these changes to sustainable technologies being discussed must be accompanied by equivalent bold social changes. Social issues have to be integrated into a portfolio of demonstration projects to demonstrate industrial ecology principles. A potential demonstration is in the area of transportation, where there has been a great infusion of new technologies. Finally, in order to effectively change consumers' consumption patterns, making them environmentally aware, a participatory education program must be established.

Discussion Summary

After the presentations, a discussion and brainstorming session generated the following thoughts on ways to move industrial ecology principles forward:

Education and Training

- Organize a student challenge to come up with industrial ecology ideas.
- Institute K-12 education to increase understanding about industrial ecology and ultimately to enact a cultural change.
- Educate workers and suppliers to further the use of industrial ecology principles.
- Develop standards for environmental literacy for all levels of education.
- Enhance the general population's support of environmental products; identify environmentally preferable products with a special "seal of approval."

- Offer a "Gore Prize" (environmental equivalent of a Nobel prize) for the best ten innovative environmental systems solutions in a year.

- Increase environmental literacy by establishing internships for a target population.

- Create a media blitz to encourage the purchase of environmentally preferable products.

Methodologies and Data

- Develop criteria for judging products/materials.

- Create a database to provide access to information on product content.

- Create a database for materials selection to enable faster penetration of design for environment. Include materials productivity data.

- Create a national information system. The current system is data rich but information poor. Information should be on-line and accessible to the private sector, government, and academia.

- Coordinate the database on a national platform. The level of effort should be viewed in terms of a human genome project for the environment.

- Identify the next technological steps needed for a sustainable future.

- Examine the process of technology assessment more holistically.

- Link industrial ecology and ecosystem management.

- Develop a set of systems-wide metrics.

- Standardize environmental performance indices (many indices are being developed). They need to be harmonized, preferably at an international level to avoid creating artificial trade barriers.

- Acquire national statistics to measure materials productivity.

- Identify infrastructure and regulatory problems in recycling.

- Clarify green technologies concepts: environmentally safe and cost-effective (the "double green" concept, second green is the "buck").

- Find out where the data gaps really lie. Perform a reality check with what is in the minds of individuals.

- Identify research and development needs for anticipated problems for which we do not have solutions. Recognize their long-term nature and the need to sustain efforts.

- Facilitate information transfer on waste generation data, and on waste conversion and utilization products and markets. Provide industries with access to this knowledge.

- Use information from the more than 1,000 Cooperative Research and Development Agreements now in place, when allowed by intellectual property provisions, to inform and assist industrial partners.

- Identify innovations to replace BACT (best available control technologies) and others.

- Increase the information pool for design of industrial ecology demonstrations from case studies from other countries.

Systems

- Develop disassembly systems.

- Consider just-in-time processes.

- Develop the design for of end-of-life systems.

- Develop the design for recycle systems.

- Develop tools and techniques for life-cycle analysis and full cost accounting.

- Set priorities for demonstration projects. Portfolios should include both near and long-term projects customized to specific problems (must get away from data generalities). Employ a context or systems approach. Social systems interactions need to be assessed.

- Coordinate related activities to get a composite approach.

- Using Hg, As, Cd, Pb as an example, design flows through the economy and environment, and identify major points of risk for priority-setting for industrial ecology demonstration.

- Redefine site or facility to allow for two or more sites (from different companies) to operate in an integrated way.

- Use water as an industrial ecology model project in specific locations (e.g., San Francisco Bay area).

- Work on a two-pronged approach: good projects for on-the-ground demonstrations in the near term along with a focus on long-term priorities R&D. Develop experimental/empirical data to test theory and models.

Partnerships

- Make the national laboratories more accessible (for developing partnerships) and use government facilities for assessment of the feasibility of projects at early stages. Minimize the cultural differences between the national laboratories and industry for near-term activities.

- Develop government leadership to focus on long-term priorities as opposed to the "do it now" mentality. However, government leadership in the short term is imperative for demonstration and development activities jointly with industry.

- Develop criteria to facilitate greater cooperation within industries.
- Facilitate cooperation between companies of different industries to catalyze ideas.
- Create industry-university partnerships, e.g., for pollution prevention, industrial ecology, and waste minimization.
- Establish internships in industry to increase industrial exposure for national laboratory and university personnel.
- Develop partnerships among DOE, the national laboratories, and public utilities.
- Use multinational U.S.-based corporations as mechanisms for exporting environmental technologies and globalizing environmental technologies.
- Integrate energy recovery and material substitution/efficiency using a government/private sector partnership to implement.
- Use partnerships among government, academia and industry to study short-term global problems (national and international).
- Increase teamwork among researchers, technical vendors, entrepreneurs, government, users, and all stakeholders. This teamwork will help define and refine processes to implement industrial ecology principles.
- Facilitate information sharing in industry.
- Facilitate an industry shift way from the quarterly profits mentality.

Policy

- Harmonize federal, state and local regulations.
- Establish a green process advisory system.
- Establish policies to encourage internalization of environmental costs.
- Revise federal regulations and acquisition procedures.
- Link the ecosystem management effort with the industrial ecology initiative on the policy front.
- Encourage fast track permitting for green technologies.
- Recognize that the federal government's role includes basic research, research and development support, funding of projects and establishing regulatory standards.
- Establish regulatory changes to facilitate testing and development of new technologies.

Incentives

- Offer tax incentives for demonstration projects.
- Offer incentives from government to take risks (e.g., tax incentives)
- Remove the existing policy impediments for recycling and preferences for virgin materials.
- Offer tax credits for demonstration projects.
- Encourage longer term, higher risk R&D in both government and industry, in the area of industrial ecology to begin longer term cooperation.
- Increase the cost of natural resource inputs (as labor and capital are already taxed).
- Establish green indices for investment portfolio assessment (e.g., stocks measured by environmental as well as economic performance of the companies).
- Offer a "million dollar prize" incentive, as Monsanto has, to encourage creative solutions for waste problems.
- Decrease the short- term outlook by companies and investors (get beyond quarterly reports).
- Level the playing field between raw and secondary materials by raising the cost of raw materials (or by providing incentives to the use of recycled materials).
- Encourage the leasing of raw materials (as done by the Germans).
- Work through GATT to establish international standards to make the global market a level playing field.
- Use recycling to create domestic jobs.
- Increase emphasis on materials productivity in reporting national statistics.
- Incorporate a longer time frame in industry decision making.
- Emphasize material productivity and more efficient uses of materials.

Additional Issues

- Base the future on renewable energy sources (e.g., hydrogen) where today's economy is based on non-renewable fuels. Focus research and development investment on energy sources that are truly sustainable and have the potential to become cost-competitive if externality costs are included.
- Furnish clean coal technologies to China, India, and other nations endowed with these raw materials in the near term, or help them leapfrog directly to sustainable technologies through appropriate financial mechanisms.

- Follow up concerning post-Rio United Nations actions, as well as German actions, with regard to international cooperation on systems analysis, with more emphasis on multi-disciplinary areas .

- Recognize government as a purchaser.

- Examine ISO 14000 environmental management systems as alternative models for achieving or exceeding compliance.

- Recognize countries with outdated infrastructures and no capital and the role of appropriate technologies.

Industrial Ecology Examples of Policy Options

This breakout session also generated the following examples of policy options:

Government/Industry/Academia Roles

Government should provide the framework, data and information systems, as well as a catalytic and facilitative role, principally in the development of the science and technology base for industrial ecology in partnership with industry and academia. Over time, a partnership among industry, government, and academia is emerging. Even now, courses on the science of industrial ecology are being taught. Industries can implement pathways that combine market attractiveness, environmental protection, and resource efficiency.

Basic and Applied R&D and Systems Integration

Focus on fundamental and applied R&D to broaden the scientific foundation for future applications of industrial ecology. Address integrated technological systems through data collection, interpretation, and modeling to describe current and future complex infrastructure options through partnerships.

Data/Analytical Tools/Decision Making Support

Coordinate, identify and fill gaps, and integrate existing data and create databases in standard, accessible format of flows of raw materials, wastes, energy, water, and environmental conditions at local, regional, national, and global levels, and of environmental technologies, to develop analytical and visualization tools for decision-makers to assess total life cycle costs of different infrastructure choices.

Specific Regional/Local Demonstrations

Implement and assess the application of industrial ecology principles on select specific integrated industrial, urban, agricultural, airshed, and watershed demonstration sites. Circumstances include existing and evolving brokerage functions to match industries, resources, and desired products or functions. The selection criteria should include economic, social, and environmental factors such that all aspects of the demonstration can be assessed. Use lessons learned for developing and refining operational practice.

Public Education

Provide public education on industrial ecology benefits through showcase demonstration projects in collaboration with industry, academia, and other stakeholders. Environmental awareness and understanding of science-based risk in our society are key components.

Changing the Regulatory Structure to Expedite Inter and Intra Firm Collaborative Activities

Establish processes for accelerated inter- and intra-firm collaborative activities to encourage the demonstration and market introduction of technologies for industrial ecology. Establish a structure for identifying and implementing unique innovative systems approaches based on industrial ecology and for identifying and mitigating unnecessary barriers (permitting and others) to environmentally preferable technologies and systems.

Flexible Regulations Needed

Create flexibility to encourage first use of new technologies and encourage experimentation with new approaches to mitigating the environmental impacts of economic activity. The demonstration process for new technology should be simplified and different sets of regulations for demonstrations should be minimized. The regulatory systems overall should provide flexibility, preserve accountability, and encourage efficiency to increase competitiveness and environmental protection.

Globalization and Non-Environmental Regulatory Practices

Allow transnational companies to be major players both in the development and deployment of systems and technologies in collaboration with government. Industrial ecology benefits from local and global associations. Minimize the impact of non-regulatory practices (such as antitrust laws, government procurement, consumer protection, etc.) to expedite the development of environmentally preferable technologies and facilitate intrasectoral cooperation.

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Renelle Rae, U.S. Environmental Protection Agency (Facilitator)
Charissa Rigano, Waste Policy Institute (Rapporteur)
Merrill Smith, DOE (Assistant Rapporteur)

Breakout Session 14
Service Industries and the Environment

Co-Chairs: **Dave Rejeski, Program Manager, White House Office of Science and Technology Policy (OSTP)**
James Quinn, Professor of Business Administration, Tuck School of Management, Dartmouth College

Breakout Background

This breakout session focused on the use of environmental technologies in the service industries. Participants included representatives from numerous different service industries and leaders of various non-governmental organizations (NGOs). The main goal of the session was to obtain views on ways the government might better address environmental issues as they affect the most substantial segment of the U.S. economy. The major message from the breakout session was that, although the service sector is by far the largest segment of the economy both in terms of employment and Gross National Product (GNP), it is overlooked by policymakers in the environmental arena.

Summary of Key Issues and Suggested Actions

- Widely publicize the size and scope of the U.S. service industry, its environmental impacts, and the potential for enhancing environmental protection.
- Conduct detailed research and data analysis on the service sector, focusing special attention on the different life cycles in this sector.
- Develop new processes for environmental planning, impact analysis, and conflict resolution.
- Create partnerships among government and the service industry.
- Ensure that government environmental policies related to the service sector have a strong educational component.

Session Presentations

Co-Chair **David Rejeski**, OSTP, began by observing that this conference would be ignoring a large part of the economy if it failed to treat the service sector. The service sector plays a large role with regard to the environment. Rejeski added that in terms of environmental matters, a "quiet revolution" is occurring in the service sector as consumer practices change. The Clinton Administration will continue to seek new and better ways to interact with the service sector to obtain greater efficiencies. Rejeski expressed appreciation to the National Academy of Engineering (NAE) for assistance in organizing this session.

Co-Chair **James Brian Quinn**, Dartmouth College, said that policymakers are insufficiently aware that the service industry is important. Yet, it is the fastest growing area of the U.S. economy (78 percent of all employment and 74 percent of the GNP is now in the services sector). In most

countries within the Organization for Economic Cooperation and Development, the service sector comprises only 65–70 percent. Quinn provided details on the service sector of the U.S. economy:

- The service sector is comprised of finance, retail, wholesale, transportation, communications, public utilities, health care, and other services.

- The financial services industry is equivalent to manufacturing in terms of size. Large handlers of products have enormous impact on the way products are specified and manufactured. Many service industries are high-tech industries; all are very powerful. For example, the finance industry is the largest buyer of information technology by far.

- Service companies are very sophisticated. McDonalds feeds 20–30 million people every day. The service sector uses more paper than any other sector of the economy. The service sector is also more capital-intensive than manufacturing.

- The value-added per person in the service sector is almost equal to the manufacturing sector. The service industry no longer can be considered a low-wage paying sector having only beginning level jobs.

- It is the most stable area of the economy—there has only been one quarter since 1950 when this sector has not grown. Its impact on technology is high.

- The United States is very good at service, especially in productivity; Americans in the service industry are more efficient than even the Japanese. In transportation, the United States is more efficient by 54 percent.

- With regard to size, the service sector is becoming bigger than the manufacturing sector. For example, Toys R Us is larger than all or most of its suppliers. The firm has information on the marketplace that no one else has. In the transportation industry, the only company larger than the airlines is Boeing, which has to have airlines' input on exactly what they need.

- The growing temporary services industry is now bigger than all of its customers.

- Sports is becoming a "mega" industry. For example, a single event will sell $50 million worth of tickets. Entertainment is America's second largest export. The value of financial exchanges is $4 trillion per year.

Quinn commented that even though the manufacturing sector is staying level, government keeps looking at it in every possible way. And yet the service sector is largely overlooked. Quinn asked the breakout session participants to consider the degree to which the service industry provides opportunities for pollution prevention and clean up. He noted that many fast food companies have reduced their use of packing (e.g., McDonalds). If Toys R Us dictates a packaging standard, the manufacturers will follow. Service companies clearly have great power to affect practices that impact on the environment. Quinn challenged the breakout session to consider, from an environmental technology perspective: ways to collect and disseminate information about the service industry, new data needs, bottlenecks to be removed, necessary incentives, and R&D initiatives.

Damian Saccocio, NAE, asked the representatives of the service industries present to share with the group environment-related problems, experiences, and opportunities in their industries.

Discussion Summary

Retail: There is on-going consolidation in many sectors. The decisions of a few large companies define consumers' environmental choices and they make/break suppliers. They also present huge educational opportunities. Large retailers have leverage due to tremendous buying power. One solution that probably will not work here is "eco-labeling." Europe has been doing this. But some large retailers do not want this.

Mail Order: The choices of businesses regarding whether to use air versus land freight delivery greatly impacts costs, as well as the environment. There also is a new choice vis á vis home shopping versus mail. There are huge volumes of merchandise involved (e.g., FedEx may move more than 1.5 million packages per day). In the manufacturing industry there are many more products in transit more of the time.

Restaurants: National chains have tremendous buying power and economies of scale in their buying of everything from paper products to the way beef is grown and carved. Locally, even "fine," upscale restaurants also can play a role (e.g., Chef's Collaborative 2000).

Sustainable Agriculture: This is the way that restaurants and food stores want their food supplied which, in turn, affects the way food is grown.

Telecommuting and "distributed work": The growth of these practices can result in fewer vehicles on the roads, but can also result in increased home dispersion. The big question is what is the impact on travel?

Hotels and Motels: They are seeking to reduce their environmental impact and costs (e.g., towels, soap, lighting, etc.). They serve literally thousands of clients per day, and there are huge opportunities for awareness and education. For many items used in the service industry (e.g., drinking cups), there have been no total life cycle cost studies concerning alternatives. One hotel noted that 33 percent of its consumer comment cards mentioned the hotel's environmental consciousness program. A hotel saved over two million one-ounce bottles simply by switching from disposable complimentary shampoo to dispensers.

Real Estate and Architecture: This industry plays a critical role in determining energy, transportation, water, and waste flows, but decision making is ad hoc and uneven.

Entertainment: Just consider theme parks (e.g., Anheuser-Busch has over 22 million visitors per year at its parks).

Health: This is a huge industry comprising over five percent of the nation's GNP. One teaching hospital has calculated its pounds of waste per day per bed at 32. The result was astounding, and they are now developing methods to reduce it. There are numerous ways to save money and improve efficiencies by focusing on improving environmental methods in the health care and health service industries.

Waste Services: These are the "pros" in the environmental industry and can be called upon by other industries to do waste audits and give advice on ways to accomplish pollution prevention. They can be encouraged to form partnerships with companies to reduce pollution and improve efficiencies.

After discussion about the foregoing points, the group decided on a major theme: The service industry is a major economic sector in this country: 75–78 percent of the economy. Currently, it is not a focus for environmental policy. There are great opportunities for incorporating and expanding the role for environmental service industry. It is a sector that is very capital and technology intensive. Major observations from the discussion are as follows:

- Most regulations are "end of the pipeline." They may work well with manufacturing, but when applied to the service industry it is a "force fit."
- The manufacturing model is inappropriate to the service economy.
- The service industry has a huge role in education; its companies can use advertising to educate consumers on environmental protection.
- The service industry's scale is huge; it wields enormous power with regard to the actions of its suppliers. It has tremendous leverage with manufacturers; it has the opportunity to pressure consumers and manufacturers and to influence change.
- The service industry engages in regular, extensive dialogue with suppliers and consumers. It can be flexible working with differing political, cultural, and regulatory environments.
- It feels the environmental urges felt by the consumer first. The industry's needs to build over-capacity to meet potential customer needs results in increased environmental consequences.
- Environmental protection in the service industry can be achieved without any lessening of service quality.
- The United States is experiencing a shift from a commodity base to a knowledge base—knowledge will grow through distributed systems.

It is easy to imagine tremendous opportunities for increasing efficiency and reducing environmental damage. For example FedEx ships 1.5 million packages per night involving 450 aircraft and 31,000 vehicles. A study by the Electric Power Research Institute shows that the United States could reduce its energy use by 50 percent without reducing the national standard of living. NYNEX printed each phone bill on both sides of the page and saved 25 percent of its paper and $4 million per year. A 1,000-room hotel stopped putting complimentary shampoos in throwaway bottles and replaced them with dispensers, thus saving two million one-ounce bottles.

Facilitation Team

Gary Knight, Waste Policy Institute (Rapporteur)
Homer LaRue, Howard University Law School (Facilitator)
John Meeker, U.S. Environmental Protection Agency (Assistant Facilitator)
Damian Saccocio, National Academy of Engineering (Session Planning)

SECTION C

ROUNDTABLE SESSION

SUMMARIES

Roundtable 1
Research and Development

Co-Chairs: **Neal Lane, Director, National Science Foundation (NSF)**
William Haney, President and CEO, Molten Metal Technologies, Inc.

Roundtable Background

More than 90 percent of the U.S. investment in environmental technology innovation is directly attributable to the private sector. The federal investment is significant, however, because of the breadth of the portfolio. Federal R&D covers a range of activities from fundamental research to mission-oriented research and from technology development activities to demonstration and diffusion projects.

There is general agreement that the effectiveness of the federal investment has suffered in the past from lack of coordination and leadership. In the 1992 report, *Environmental Research and Development: Strengthening the Federal Infrastructure*, the Carnegie Commission on Science, Technology, and Government concluded that "the existing federal R&D structure was constructed for a time and a set of issues that no longer correspond to today's demands."

To help strengthen the federal infrastructure and increase the return on society's investment, the Clinton Administration has put in place a forward-looking framework for approaching environmental R&D. This framework is based on the principles of quality, coordination, facilitation, partnerships, and sustainability.

Summary of Key Issues and Suggested Actions

- The federal government should set priorities using a risk-based approach and an inclusive process that takes advantage of the expertise of users and stakeholders in the private sector.
- The federal government should focus its R&D resources on what it can do particularly well, emphasizing long-term, high risk, and generic R&D.
- The federal government needs to improve communication both internally and with the private sector as part of a comprehensive effort to define needs, standards, and performance results.
- The federal government should employ new partnerships and engage in regular, extensive dialogue with the private sector, focusing particularly on regional and local issues where the government role in R&D for avoidance, control, monitoring, and remediation can be clearly defined.

Discussion Summary

Roundtable Co-Chair **Neal Lane**, NSF, opened the roundtable by welcoming all participants and explaining the structure of the roundtable discussion. Lane stated the purpose of the roundtable was to examine the focus of the federal investment in research and development (over $5 billion annually). Next, he invited each of the roundtable members to introduce themselves to the audience

(roundtable members are listed below). Lane then introduced **Robert Huggett**, U.S. Environmental Protection Agency (EPA), and **Joseph Bordogna**, NSF, who chaired the previous day's breakout sessions on, respectively, "Verification and Testing of Environmental Technologies" and "R&D to Commercialization Continuum." Each provided a summary of the findings from their sessions which are described elsewhere in these proceedings.

In his introductory comments Co-Chair **William Haney**, Molten Metal Technologies, Inc., said that the federal government needs to leverage its R&D investment. The first priority for the federal government is to unleash new capital from the private sector for R&D. Most R&D is funded by private sources (90 percent versus 10 percent from the federal government). If the amount from the private sector could be increased marginally there might be greater effect than trying to increase the federal contribution when budgets are decreasing. To attract this new capital the federal government must develop consistent, long-term, multi-tiered, and multimedia environmental standards. The federal R&D funds need to be applied at the right time during technology development and be focused on broadly applicable technologies that will solve a number of environmental problems. The federal government must work in partnership with industry after the priorities are identified. The federal government can furnish money, provide cooperative access to facilities, become the first adopter of new products, allow permitting flexibility, and provide other incentives. Finally, the federal government has a major role in verifying and legitimizing the success of new environmental technologies and accepting the failure of technologies as well.

The discussion of the roundtable members was structured around three key questions listed below.

Question 1: How should federal R&D be balanced among remediation and avoidance investments?

Kathryn Sullivan, Department of Commerce, explained that through use of a systems approach to research federal R&D can get more results from its 10 percent contribution to overall U.S. R&D. Monitoring and assessment technologies can be used in process research about the natural environment and assist in making real time operational decisions in complex environments. When making continuous, in-situ measurements, knowledge of the natural environment, data, information, models, and computational abilities are critical. These capabilities need to be state-of-the-art, and the United States should preserve its current position of leadership. In addition, there is a sizable export market for monitoring and assessment technologies that should not be overlooked.

Brad Allenby, AT&T, noted that current R&D funding is focused on remediation and compliance issues. Unfortunately these expenditures will not help achieve a sustainable economy. That is not to say that remediation issues are not important to address, but the federal government needs to look beyond today's problems and focus its long-term resources on research that will help to transform the economy to sustainability. A fundamental change is needed throughout the economy. There is a need to "reengineer" the Industrial Revolution. Allenby opined that the conference had too little representation from the service industries that make up over 70 percent of the economy. By focusing much of the discussion on manufacturing, only a relatively small part of the economy is being addressed. The federal government should take the lead and start analyzing the increasingly important service component of the economy.

Anita Jones, Department of Defense (DOD), expressed the concern that there are not enough resources to explore all the promising ideas in environmental technology. Within DOD, R&D investments have emphasized remediation and avoidance technologies with less effort focused on

conservation and compliance. This allocation is based on the immediate needs of the users in industry and the military services. However, the trend is to apply more resources to avoidance and less on remediation and compliance. She added that a return on investment calculation for environmental regulations that impede progress of technology application needs to be completed.

Question 2: ***What are the appropriate roles of the public and private sectors in R&D? How do the roles vary among different interests, e.g., small versus large and among different sectors, e.g., manufacturing versus services?***

Darryl Banks, World Resources Institute, suggested that there are three things which the federal government could do well and do best:

- Set the stage, make the rules, and establish the boundary conditions through consistent, flexible regulatory and fiscal policies that can be catalytic and supportive in accelerating innovation.

- Develop innovative, environmentally critical technologies in the generic and pre-competitive stage of development through joint, competitive partnerships with industry and academia in areas where immediate economic returns are not evident and risk is high.

- Lead the nation in establishing a framework for demonstrating and verifying environmental technologies.

David Sharma, Department of Transportation, stated that it is important for the federal government to integrate planning, work in partnership with industry, and focus much attention on standards. Environmental technologies need to be developed within a common architecture.

Charles Kennel, National Aeronautics and Space Administration, summarized the findings from the breakout session he chaired on "Environmental Monitoring and Information Access." He said that data collected by government needs to be merged with social and economic data. To accomplish this end, partnerships are essential. The federal government sets the standards across the states. The federal government is needed to sustain long-term monitoring commitments. Money is not the essential barrier to information dissemination. There is more need for cooperation among the government agencies and various sectors of society. Government must empower decision making to the lowest possible levels and seek partnerships to suit the needs of users.

Earl Beaver, Monsanto Company, stated that federal R&D is focused in remediation and control technologies, but avoidance technologies are what manufacturers need. Industry and other owners of problems are not communicating their needs and priorities. The federal government needs to encourage conversations about the true priorities and to encourage a shift toward better process technologies (e.g., water re-use, a major issue for manufacturers). The federal government should facilitate the establishment of priorities and communicate them to those who would solve the problems.

Bruce Piasecki, Rensselaer Polytechnic Institute, cited a Booz-Allen, Hamilton survey of 5,000 environmental technology professionals indicating that less than five percent thought future environmental R&D opportunities were in remediation and in enhancing pollution control technology. What consumers need is better products. If researchers only look at remediation and compliance technologies, there is less margin for profitability for the private sector. In deciding priorities, consumer needs should be considered.

Lucien Bradet, Industry Canada, noted that there are two different sets of roles for government and the private sector. The government looks at issues and focuses on dealing with social and political issues. Private industry's role is to be market responsive to the needs of consumers. Where the two roles meet is where government helps industry to create new jobs. Government should share the risk at the "right moment" in the development cycle where one company could not do it alone.

Question 3: ***How can R&D resources be strategically linked with the needs of industry, state and local governments, non-government organizations (NGOs), and other stakeholders?***

William Reber, Motorola New Enterprises, said that government should use its resources to identify bright, talented people who have ideas. Government can develop relationships among people in relevant ways of working together. Government is the gluing function to help provide people with management and marketing skills that may be missing in the development of new ideas. It is not easy to move technology from the lab to the field. Government should focus on supporting small businesses which are more in touch with local needs.

Albert Grant, American Association of Engineering Societies, stressed the need to not overlook the construction industry, which contributes 13 percent of the Gross National Product and is the nation's second largest economic activity. However, it is a diverse and fragmented industry with over a million independent firms employing over 10 million people. The industry invests less than 0.5 percent of its sales in R&D. Grant noted that there is a difference in each industries' needs for remediation and avoidance technologies. People spent 90 percent of their time in an indoor environment, so it is necessary that there be balance between emphasizing the inside versus the outside environment. For the building industry, improving air quality in existing buildings and energy conservation are major issues. Since the federal government is a large and significant consumer, there is an opportunity to encourage industry investment in R&D. By setting performance requirements and guaranteeing purchases from industries that meet the requirements, new markets can be created.

Martha Krebs, Department of Energy (DOE), observed that DOE is at the nexus of environmental technology discussions. DOE has emphasized working with small business, academia, and the national laboratories. DOE is looking at long-term research needs and is taking a holistic approach There are real missions and milestones to be met every year. DOE is making strong investments in basic science, working with industry, and trying to shorten the cycle time for the R&D continuum. DOE is making more use of peer review in deciding priorities.

Kofi Bota, Clark Atlanta University, stated that colleges and universities have a responsibility to look at a sustainable future. The NSF and EPA should call on universities to look at the sustainable future so that processes, education, and R&D programs include this new paradigm. Universities should sponsor a summit with key national leaders to discuss this issue.

Steven Levitas, North Carolina Department of Environment, Health, and Natural Resources, raised a fundamental question about the public's perception that there is too much government, and that it does not work very well. The public wants to know what is government's role? Is it to solve the country's and the world's environmental problems, or improve domestic industry to reduce costs, or create jobs and wealth, or make the United States more competitive in the export market? The path taken will lead to different solutions. The federal government needs to do a better job prioritizing and

communicating the R&D plan. Levitas' perception is that the federal R&D plan is not working well; it is fragmented; it is uncoordinated; it lacks clear priorities; and it should be re-organized. Starting from scratch, the federal government should look at how it invests its limited resources to solve problems. There need to be better partnerships developed with industry and state and local governments.

Edward Furtek, California Environmental Technology Center, said that as we move from the post-Cold War environment, where the threat was clear, to today's environment, the challenges are not clearly defined. Part of the key is development of partnerships with local stakeholders where the unique problems reside. By working close to the problem holders, the federal government can better shape its agenda, decide what the balance should be, and determine what its role should be.

Co-Chair Bob Watson, White House Office of Science and Technology Policy, highlighted the roundtable's issues and suggestions:

- Focus on the link of R&D down the technology pipeline. A verification/demonstration and regulatory framework is needed.
- Stress avoidance technologies, but do not lose sight of the need for remediation technologies.
- Create partnerships throughout R&D efforts. Government should take the lead sponsoring high-risk, long-term R&D.
- Provide better access for companies to federal facilities.
- Remember that the federal government as a major consumer sends important signals to the marketplace.
- Ensure that R&D is broad based and includes the service sector.
- Identify and ameliorate barriers within the regulatory framework which impede capital formation, verification, and certification.
- Prioritize the goals, e.g., jobs, market opportunities, environmental challenges, and global commerce

Watson underscored that this roundtable and conference are part of a national dialogue to determine priorities and decide which technologies have the potential to succeed in the marketplace. Co-Chair Haney summed up the roundtable by noting three needs:

- Develop an inclusive process to set risk-based, long-term R&D priorities.
- Have the federal government focus its R&D efforts to use its resources more wisely—even though increased federal funding is not required.
- Increase communication among federal agencies, industry, academia, and consumers to identify needs, define standards and share performance results in the United States as well as with the international community.

Roundtable Members

Industry:

Brad Allenby, Research Vice President for Technology and Environment, AT&T
Earl Beaver, Director of Waste Elimination, Monsanto Company
William Haney, President and CEO, Molten Metal Technologies, Inc. (Co-Chair)
William Reber, Motorola New Enterprises

Academia:

Kofi Bota, Vice President for Research, Clark Atlanta University
Bruce Piasecki, Director of Environmental Management and Policy Programs, Rensselaer Polytechnic Institute

Non-Government Organizations:

Darryl Banks, Director of Environmental Technology Programs, World Resources Institute
Albert Grant, American Association of Engineering Societies

State and Local:

Edward Furtek, Deputy Director, California Environmental Technology Center
Steven Levitas, Deputy Secretary, North Carolina Department of Environment, Health, and Natural Resources

International:

Lucien Bradet, Industry Canada

Federal Agencies:

Robert Huggett, Assistant Administrator for Research and Development, U.S. Environmental Protection Agency
Anita Jones, Director of Defense Research and Engineering, Department of Defense
Neal Lane, Director, National Science Foundation (Co-Chair)
Charles Kennel, Associate Administrator for Mission to Planet Earth, National Aeronautics and Space Administration
Martha Krebs, Director of Energy Research, Department of Energy
David Sharma, Administrator of Research and Special Programs Administration, Department of Transportation
Kathryn Sullivan, Chief Scientist, National Oceanic and Atmospheric Administration, Department of Commerce
Robert Watson, Associate Director for Environment, White House Office of Science and Technology Policy

Roundtable Support Team

Penny Firth, National Science Foundation (Roundtable Planning)
David Patterson, Waste Policy Institute (WPI) (Prime Rapporteur)
Charissa Rigano, WPI (Assistant Rapporteur)

Roundtable 2
Incentives for Innovation

Co-Chairs: **Fred Hanson, Deputy Administrator, U.S. Environmental Protection Agency (EPA)**
Richard Ayres, O'Mulveney and Myers

Roundtable Background

One of the most important challenges facing government is the need to identify the appropriate mix of legislative, fiscal, and regulatory mechanisms to stimulate the development and commercial use of environmental technologies. Markets for environmental technologies are shaped, stimulated, and at times inhibited by statutes, regulations, and fiscal and procurement policies. The goal of the Clinton Administration is to increase the flexibility of the regulatory structure as well as the open market system to encourage greater innovation in environmental technology.

Summary of Key Issues and Suggested Actions

- In its non-regulatory role as a customer for environmental technology and services, government should: assist innovative technology vendors through verification programs; expand the use of government laboratories and facilities as test beds for demonstrations; and act as a "first purchaser" of promising but unproven technologies.

- In its role as regulator, government should: make policy and regulations more user-friendly; streamline the permitting process; and reduce administrative process requirements for firms that do more than meet minimal compliance standards while maintaining accountability.

- In the context of its role as environmental steward, government should facilitate private efforts to develop innovative technologies through: the development of market-based systems such as "emissions trading"; performance-based standards; public-private partnerships such as the "Greenlights" and the "Golden Carrot" programs; and providing information about energy and environmental technologies to better inform consumer and corporate choices.

Discussion Summary

Roundtable Co-Chair **Fred Hanson**, Deputy Administrator of the U.S. Environmental Protection Agency (EPA), opened the roundtable by describing the objectives of the discussion and summarizing the recommendations from the earlier breakout sessions addressing "Regulatory Policy" and the "R&D to Commercialization Continuum." Hanson then introduced Co-Chair **Richard Ayres**, a partner with the environmental law firm of O'Mulveney and Myers. Ayres cited the following barriers to technological innovation:

- The regulatory system fails to recognize that the environment is "seamless."

- Technology-based regulations lock-in existing technologies and fail to promote pollution prevention.

- "Command and control" regulations cause industry to wait as long as possible to comply.
- "Command and control" regulations do little to produce good environmental data.

Ayres then suggested the following corrective actions to stimulate the development of new technologies:

- Government agencies should develop performance-based standards.
- Government must find ways to minimize the risk to industry of using innovative technologies.
- Voluntary audit approaches should be developed.
- Government should provide rewards for "extra performance," meaning that government should set standards and establish a reward system and reduce administrative process requirements, for those companies that go beyond compliance.
- Tax policy should be examined in terms of incentivizing the use of innovative technologies.
- Market-based systems such as "emissions trading" should be put into the regulatory framework.

In regard to reliance on market-based approaches generally and the issue of salable emissions credits, Ayres advocated that the government establish compliance goals and then let the polluters find the most efficient way to meet such goals.

Following the introductory presentations by Hanson and Ayres, the discussion was opened for general comments by the participants. A number of speakers echoed or endorsed the comments already made by the co-chairs, and the following additional points were made:

James Strock, California EPA, emphasized the need for permitting reform, noting that there are 200,000 people employed in the environmental technology field in the state of California, where annual industry revenues have reached $20 billion.

David Bodde, Midwest Research Institute, emphasized that inflexible and overly prescriptive regulations are harmful to business and retard the development of new technologies. He cited what he characterized as a "burdensome" permitting process; and commented that "people are averse to risk-taking" and prefer "known technology off-the-shelf." According to Bodde, there is a lack of information about new technologies. This situation adversely affects corporate decision making. He also cited the adversarial context for resolution of environmental issues as a major constraint.

Eugene Berman, Vice President, Molten Metal Technology, Inc., described his company's experience in developing a catalytic extraction process. Berman depicted Molten Metal's five-year road to commercialization of a recycling technology as time-consuming and costly, and emphasized that without his company's large budget, the commercialization efforts would have failed due to lack of funding. Today, while not yet achieving profitability, Molten Metal's efforts have resulted in the first hazardous waste recycling facility in Massachusetts. Berman highlighted another key component of his company's successful commercialization program as being the utilization of a certification process for their technology; this process allowed their technology to avoid the pitfalls of repetitive demonstration and continual validation requirements. Molten Metal encountered in Texas and

California state-run technical certification programs that gave their technology an expedited "stamp of approval" within the respective states.

Jack Silvey, Dynamac Corporation, stressed the importance of government leadership in developing "certification" programs, and spoke of the paramount importance of "performance-oriented standards" to remove "uncertainty from the equation for industry."

Tim Searchinger, Environmental Defense Fund, made the following points in support of implementing an "emissions trading system": (1) there should be "phased-in" standards with on-going research; (2) more environmental groups should be involved in the environmental data collection and quantification process; and (3) there is a need to move toward less discretion in the enforcement process with "specific, mandated results." Searchinger is an advocate of automatic enforcement with industry having the ability to purchase "emissions credits."

Al Alm, Science Applications International Corporation, cited the need to loosen up the regulatory system (e.g., emissions credits are an excellent idea where applicable). He called for a "beyond compliance" approach. Firms that do more than the minimum, or commit to pollution prevention, would benefit from regulatory flexibility. There is a need to secure commitments for voluntary action and emphasize a more decentralized system. Demonstration and verification are keys to stimulating the development and commercialization of new technologies. Furthermore, incentives should be turned around: "regulators need incentives."

Roy F. Weston, President Emeritus of Roy F. Weston, Inc., emphasized that sustainable development and protection of the environment are mutually reinforcing. Additionally, he raised an issue with respect to the legislative/regulatory resolution of technical issues: "Do lawyers or scientists decide?" Weston emphasized that resolving permitting issues will be a key to U.S. success in international competition.

Alan Miller, Co-Author of *Green Gold*, emphasized that the future lies in pollution prevention and waste minimization, and not costly remediation programs. The goal should be to develop better consumer products that meet environmental requirements. He urged the federal government to learn from the Japanese experience and develop more effective public-private partnerships.

John Preston, Massachusetts Institute of Technology, cited four questions concerning risks which companies face in technology development: Is the new technology going to work? Will management go forward with a commitment to developing the technology? Will financing issues work out? And, most importantly, are regulatory risks manageable? Preston emphasized that we must lower the regulatory burden for environmental technologies. It is especially important to eliminate uncertainty about whether companies that commit to development will ever receive a permit. The federal government should work with the states to mandate the awarding of permits, subject to demonstrating compliance. Lastly, Preston advocated that government finance any new environmental technology pilot demonstration, regardless of whether the government needs the technology.

Roundtable Members

Industry:

Al Alm, Science Applications International Corporation
Richard Ayres, O'Mulveney and Myers (Co-Chair)

Eugene Berman, Molten Metal Technology, Inc.
Frank Pope, Technology Funding, Inc.
George Scalise, National Semiconductor Corporation
Jack Silvey, Dynamac Corporation
Roy Weston, Roy F. Weston, Inc.

Academia:

Bunyan Bryant, University of Michigan
Alan Miller, University of Maryland
John Preston, Massachusetts Institute of Technology

Non-Government Organizations:

David Bodde, Midwest Research Institute
Tim Searchinger, Environmental Defense Fund

State and Local:

Peter Hurley, Washington State Environmental Council
Lee Paddock, Minnesota Attorney General's Office
James Strock, California Environmental Protection Agency

International:

Torstein Bergen, Norsk Hydro A.S.

Federal Agencies:

Peter Fox-Penner, Department of Energy
David Gardiner, U.S. Environmental Protection Agency (EPA)
Fred Hanson, EPA (Co-Chair)
Katie McGinty, White House Office on Environmental Policy

Roundtable Support Team

Corey Cooke, Waste Policy Institute (WPI) (Assistant Rapporteur)
Sandra Panetta, EPA (Roundtable Planning)
Brad Penney, WPI (Prime Rapporteur)
David Weiss, WPI (Assistant Rapporteur)

Roundtable 3
Exports and Global Markets

Co-Chairs: **Ray Vickery, Assistant Secretary for Trade Development, U.S. Department of Commerce (DOC)**
Donald Connors, President, International Environmental Business and Technology Institute

Roundtable Background

The rapidly growing world market for environmental technologies presents tremendous opportunities for internationally competitive U.S. firms. U.S. environmental technology companies, however, face the inherent challenges of an industry largely shaped by government programs and policies. Environmental regulations; international agreements and standards; a unique set of national and subnational markets; and increasing competition from nations who provide a significant amount of support to their industries are influencing U.S. competitive standing in the international marketplace. These factors highlight the need for a focused U.S. strategy to assist environmental technology exports. The federal government provides a number of export programs that assist U.S. industry to obtain access to financing, identify foreign markets, and match foreign market needs to U.S. supplier goods and services. The U.S. Government is also facilitating the development of international treaties and agreements that help shape the international market for greater receptivity to U.S. goods and services. At issue for this roundtable was whether the federal government should do more to promote environmental exports, and specifically, should the government use financial assistance to encourage U.S. environmental exports, either as a precise focus of action or as part of a broader strategy to link aid and export policies more closely?

Summary of Key Issues and Suggested Actions

- **Fostering Global Market Opportunities.** The government role is to drive the creation of demand for environmental technologies while formulating and implementing a strategy that will give U.S. companies the help they need to increase exports and create U.S. jobs. The industry role is to look at the total solution to environmental problems and to emphasize technology development by producing viable products to satisfy both internal and external market demands.

- **Public-Private Partnerships.** The team approach is vital to analyzing market demands and building relationships that facilitate export trade. New partnerships with key industries are necessary to establish mutual government-industry environmental goals and to revise regulatory programs. Interagency activities are critical to assist industry in opening markets, to be an advocate for U.S. industry, and to offer counseling services.

- **Investment and Finance.** Trade and finance go hand-in-hand. The private sector has the fundamental role in funding overseas ventures, but public-private partnerships, with matching funds, can provide significant returns and successes. Priorities must be set and public funds that are available must be focused.

- **Building Capacity Overseas.** Institution-building cannot take place in the business sector alone. The key is to link the commercial and institutional aspects of promoting sustainable

development. The business community must over the long term build environmental infrastructure while working with the federal government to develop international markets.

Discussion Summary

Roundtable Co-Chair **Ray Vickery**, DOC, opened the roundtable by welcoming all participants and explaining the structure and goals for the roundtable discussion. Vickery stated that this roundtable was designed to examine the role of the United States in promoting sustainable development abroad. Next, he asked each of the roundtable members to introduce themselves to the audience (each member is listed below). Vickery then provided an overview of the breakout sessions on "Environmental Technology Exports" and "International Market Assistance," respectively, which were held the day before and which fed into this particular roundtable. Summaries of these breakout sessions are provided elsewhere in these proceedings. The discussion among the roundtable members was structured around four key questions:

Question 1: ***What are the appropriate roles of government and industry in promoting U.S. environmental technology exports?***

Roundtable Co-Chair **Donald Connors**, International Environmental Business and Technology Institute, explained that from an industry perspective, government can have an enormous influence on the global environmental market. Industry underestimates the role that the U.S. Environmental Protection Agency (EPA) can play in international standards and policy development, especially in developing nations which are just beginning to develop their environmental regulatory infrastructure. The U.S. Agency for International Development (USAID) is a key to capacity development—locally, nationally, and industrially, through training, education, and setting standards. The Department of Energy (DOE) and the Department of Commerce (DOC) as well as the new General Agreement on Tariffs and Trade (GATT) process can have significant influence on the market and contribute substantially to increased U.S. environmental exports.

Gerald Gorman, General Electric Environmental Services, Inc., believes that industry must look for a total solution to the world's environmental challenge. He stated that U.S. industry should emphasize technology development with the specific objective to develop valuable by-products for internal and external use. Then, the federal agencies should link their activities to focus their assistance efforts and eliminate duplication.

Nancy Pfund, Hambreckt and Quist, stated that most companies doing business in Asia are focusing on the main technological areas, and environmental technologies are the spin-offs. Most companies which provide environmental benefits as spin-offs do not know of the world environmental needs or of U.S. Government assistance.

David Hale, USAID, commented that the United States should sell partnerships, not products. This is important in understanding the full value of doing business with a country.

R. Jane Ginn, Catalyst International Group, concurred and added that the team approach (in public-private partnerships) is vital to analyzing the demand of the market and building relationships that support outbound trade. The consensus seemed to be that these partnerships should be built from the demand side.

Question 2: What should government's role be in building partnerships?

William Nitze, EPA, believes that new partnerships should revolve around key industries, e.g., iron, steel, and automobiles. EPA's Common Sense Initiative is trying to get industry and the government together to set goals and write regulatory programs. If the United States can establish these types of innovative partnerships, they can then teach other countries, such as Mexico, to follow the example.

Diana Savage, Cooley Godward, stated that government needs to partner with industry to identify countries and markets (especially emerging) where the United States has had difficulty in protecting intellectual property rights (IPR). With this knowledge, the federal government can assist U.S. companies in protecting their commercial products. The federal government needs to seek stronger enforcement of IPR protection and to use the U.S. Trade Representative (USTR) to put pressure on countries to comply with newly established rules on intellectual property.

Roy Carawan, North Carolina State University, expressed a concern that many countries do not enforce environmental laws with respect to the production and processing of food. Food processing is one of the largest international industries in terms of shipments abroad. Yet, many countries (mostly developing) do not adhere to environmentally-friendly production techniques to process food. This is a perfect opportunity for the United States to export "clean foods" and to supply these environmentally-friendly processes to other countries.

Paul Zofnass, Environmental Finance Consulting Group, Inc., said that there has been tremendous support from the Clinton Administration for environmental technology exports. But because of the nature of the marketplace, exporting has been limited to larger firms.

John Mizroch, Environmental Technology Export Council (ETEC), asked: What is the role of small- and medium-sized companies in the export arena? How can they play successfully? Mizroch believes that small- and medium-sized companies can play, but they have limited resources and need commitment from government to help them. Government must also prioritize the funds it spends on small business programs and communicate with small businesses to determine their needs. On the other hand, small businesses must maintain a long-term commitment to going international and refrain from quitting prematurely.

Rafe Pomerance, Department of State, stated that key elements to enhancing trade promotion are the federal agencies working together in the field and pulsing industry to determine if government is truly meeting its export needs.

Co-Chair **Donald Connors** heartily agreed and added that key government officials must be kept informed so they can keep their agency activities focused and on track.

USAID's **David Hale** continued by saying that the United States must pursue capacity building because it is in the U.S. national interest. He added that USAID could improve by expanding its understanding of industry needs and aggressively providing support for those needs.

Richard Morningstar, Overseas Private Investment Corporation (OPIC), provided a perspective on finance. He stated that government can help industry by: mitigating risk, through insurance and project financing; advocating U.S. companies' strengths and benefits abroad; reducing trade barriers; disseminating information; and identifying business opportunities. Morningstar said that by

definition the role of government is limited. It does not have enough money to fund everyone and everything. Therefore, the government role should be focused.

Question 3: ***Should the government provide widespread grants to support environmental technology export? Especially for small and medium sized business? At a time when government is shrinking?***

Jane Ginn stated that she felt that the government can provide support, but that it needs to establish priorities. Proper priorities can achieve the intended objectives and still maintain realistic budgets. In her view, the focus should be on water and wastewater treatment, with less emphasis on highly advanced technologies. Developing nations are not in a position to use U.S. state-of-the-art technologies. The United States should focus on exporting what it already has.

Nancy Pfund interjected that, at the risk of being controversial, she believes that this type of support (grants) are not the government's appropriate job. "Let venture capitalists do that," she said. Government, in her view, has a valuable role in providing information, making domestic and foreign contacts, and mitigating risks. However, it should not be in the business of "picking the winners."

EPA's **William Nitze** responded that he felt that government could be useful in helping to "prime the pump." In other words, the federal government can help to shape the international trading arena in a way that is favorable to U.S. business exports and provide the necessary information and assistance to make industry's exporting job easier. But fundamentally, U.S. business must do the exporting itself. An example of the kind of support he advocates comes from the North American Development Bank (NADB). NADB is constantly looking for quality development projects in the Americas. Although funding is limited, it can be leveraged with other development funding, e.g., from the World Bank, because these institutions have comparable funding goals and objectives. The NADB emphasis now is to support mining industry projects in Chile.

Ian Johnson, Global Environmental Facility, maintained that we must not forget the importance of our foreign customers' import policies. The U.S. Government has a major role to play in advocating sensible import policies on the part of developing nations. At the minimum, the federal government should work toward mitigating trade risks which are still a big issue. For small business involvement, proper packaging of services is the key to success.

Richard Morningstar of OPIC asserted that the government should not provide grants! U.S. industry must leverage the funds already available through institutions like OPIC. He acknowledged the difficulty for small- and medium-sized firms. OPIC itself cannot handle a great many small business loan applications because of limited financial and human resources. But, OPIC is trying to alleviate the situation by funding intermediaries, guaranteeing loan facilities in regular banks, and turning the screening process over to banks who are best at performing this function.

John Mizroch of ETEC contended that we should not give up the idea of seed money to help industry, especially for small- and medium-sized firms. Much can be accomplished with a small amount of focused dollars and strong returns. In addition, Mizroch felt that more dialogue and cooperation need to take place between U.S. embassies and U.S. export firms.

Rodrigo Prudencio, National Wildlife Federation, lamented that the results of the recent congressional elections may make moot many of the initiatives discussed here. The new Congress

will take up the debate on trade promotion and could possibly de-link trade and the environment. He expressed the important need for congressional support to keep trade and the environment linked.

Question 4: ***What is involved in building capacity? How do we mix the commercial with the institutional aspects of trade?***

William Nitze described the unlimited demand for EPA expertise around the world. The agency, though, has limited resources to provide help. Presently, EPA has dedicated funding for assistance projects in Eastern Europe and some in Latin America. EPA wants to keep the private sector informed of what the agency is doing and what the foreign needs are, so U.S. companies may recognize export opportunities. The U.S. TIES and Environmental Training Institute are programs which can help small businesses, but Nitze feels that EPA must go beyond these measures. EPA must bring the business community into the process and help revamp the environmental infrastructure. U.S. business must commit to long-term strategies that will help to develop international markets.

USAID's **David Hale**, stated that the "government and business link" is critical to saving the environment. Business needs support, and should get it if it serves all public environmental needs.

Rafe Pomerance of the State Department posed additional questions: How do we create the incentives to solve global environmental solutions? Have U.S. industry participate in negotiations on environmental issues, e.g., the greenhouse effect?

Noel Brown, United Nations Environment Programme, explained the UN emphasis on building capacity and helping developing countries. He stated that the UN's Technology Advisory Council helps developing countries to cope with environmental challenges and to select technologies appropriate for their needs. He described the UN environmental priorities as food quality, food processing technologies, and water treatment. He opined that the United States can play from a position of strength in each of these fields. World demand is critical, and the United States possesses top quality technologies in these areas.

Jane Ginn of Catalyst International Group concurred and added that the private sector can be more involved in training efficiency. It is important that a balance be achieved between efficiency and environmental standards.

In summary, Co-Chair **Donald Connors** stated his belief that environmental technology cooperation is tantamount to achieving U.S. environmental technology export success. The goal is to construct viable business-to-business relationships and to develop an environmental technology industry infrastructure. The partnerships could be extended to include trade associations, state and local governments, and non-governmental organizations. The U.S. Government can play a significant role by training and servicing industry efforts to build these types of relationships.

Co-Chair Ray Vickery summarized the entire discussion: The roundtable group agreed that, for the most part, interagency activities (e.g., the Trade Promotion Coordinating Committee) are on the right track; and that the federal government can play a significant role in opening overseas markets, advocating U.S. goods and services, providing information, and counseling U.S. companies on trade and environmental issues abroad. The objective is to focus federal government efforts on key markets and sectors. The private sector must look at the total solution to environmental problems and emphasize technology development by producing viable by-products that satisfy both internal and external market demands. The federal government recognizes that IPR protection is a fundamental

building block to succeeding in exports. Government can work within the international community to gain greater cooperation toward IPR protection. Trade and finance clearly go hand-in-hand. The private sector has the fundamental role in funding overseas ventures, but public-private partnerships, with matching funds, can provide significant returns and successes. Priorities must be set and public funds that are available must be focused. Institution-building cannot take place in the business sector alone. The key is to link the commercial and institutional aspects of promoting sustainable development. The business community must build over the long term an environmental infrastructure while working with the U.S. Government to develop international markets. This is a time of hope.

Roundtable Members

Industry:

R. Jane Ginn, Catalyst International Corporation
Gerard Gorman, General Electric Environmental Services, Inc.
Nancy Pfund, Hambrecht and Quist
Paul Zofnass, Environmental Finance Consulting Group, Inc.

Academia:

Roy Carawan, North Carolina State University

Non-Governmental Organizations:

Donald Connors, International Environmental Business and Technology Institute
Ian Johnson, Global Environmental Facility
John Mizroch, Environmental Technology Export Council
Rodrigo Prudencio, National Wildlife Federation
Diane Savage, Cooley Godward

International:

Noel Brown, United Nations Environment Programme

Federal Agencies:

David Hale, U.S. Agency for International Development
Richard Morningstar, Overseas Private Investment Corporation
William Nitze, U.S. Environmental Protection Agency
Rafe Pomerance, Department of State
Ray Vickery, Department of Commerce

Roundtable Support Team

Diana Fox-Jackson, Waste Policy Institute (Prime Rapporteur)
Robin Mackar, U.S. Agency for International Development (Assistant Rapporteur)
Ernesto Uribe, Department of Commerce (Session Planning)

Roundtable 4
Demonstration/Verification

Co-Chairs: **Thomas Grumbly, Assistant Secretary, U.S. Department of Energy (DOE)**
James Souby, Executive Director, Western Governors' Association (WGA)

Roundtable Background

This roundtable explored the role of demonstration and verification in providing a link between research and development (R&D) and commercialization of new environmental technologies. The critical link between R&D and environmental technology commercialization occurs during the demonstration phase. During this process, the viability of a technology must be verified as satisfying relevant regulatory standards while demonstrating adequate performance with respect to the environmental purpose for which it was designed. Demonstration and verification are essential in determining the useful range of performance of innovative environmental technologies and in gaining regulatory and public acceptance.

A major impediment to the commercialization of environmental technologies is the lack of financing for demonstrations, attributable to financial risks associated with investments in demonstration activities. Despite engineering successes, financial risks remain high because the value of many technologies depends on applicability as determined by regulatory processes and markets. Without full-scale demonstrations indicating desired performance and regulatory compliance, under a variety of conditions, credible performance data and permits for use cannot be obtained, nor can technology be effectively marketed. The roundtable discussions focused on steps needed to: (1) resolve industry's specific needs relating to demonstration and verification, (2) increase state and local participation in and use of the results of demonstration and verification programs for innovative technologies, and (3) reassess the roles of federal, state, and local governments in demonstration and verification programs.

Summary of Key Issues and Suggested Actions

- Although there are several experiments currently underway with respect to verification, there is a compelling need for a greater sense of urgency, both within government and the technology development community, to help expedite the process, move away from experimentation, and focus increasingly on verified outputs.

- The roundtable group is in agreement that we need to come to closure, in a quality way, on demonstration and verification processes that address the needs of all relevant stakeholders, and preferably on a single verification entity, whether a federal or third-party entity (e.g., Underwriter's Laboratory concept).

- There is a need to provide incentives, both in the private sector and in government, to developers and users of innovative environmental technologies.

- Certain barriers to innovation, especially those impeding successful demonstration and verification, need to be addressed. These include: lack of credibility, lack of uniform performance standards, lack of regulatory flexibility, inadequate information sharing and

dissemination, insufficient liability coverage, and insufficient verification and permitting reciprocity.

- There is a need to reinvent government by building in new managerial frameworks and reward systems that produce outputs and enable those involved in demonstration and verification to advance these processes.

Discussion Summary

Co-Chair **Tom Grumbly** divided the program into three areas of discussion: (1) industry needs for demonstration and verification; (2) stakeholder involvement with state and local innovations that foster enhanced participation; and (3) the enhanced role of federal, state, and local governments. He then made a general statement that government has far to go in becoming proficient at moving technological innovations from the demonstration and verification stage to actual utilization.

Issue 1 - Industry Needs for Demonstration and Verification

In shifting the discussion's focus to industry needs for demonstration and verification, Grumbly recognized **Ralph Peterson** of CH2M Hill. Peterson initiated his remarks by focusing on the five principal "customers" of technology demonstration and verification who seek technological innovations to either increase their competitive advantage or to reduce their environmental problem: technology intermediaries (e.g., consulting engineers and engineering firms); technology developers and defenders; regulators; public stakeholders; and industry facilities where environmental technologies apply. He commented that the environmental marketplace is plagued by financial and legal (e.g., long-tail liabilities) risks. In the site remediation and pollution control areas, Peterson argued that the most daunting obstacles to successful verification include variable site problems, plant-specific anomalies, varying regulatory standards and timetables, diverse stakeholders, and varying standard measures for contaminants, concentrations, and contaminant media (e.g., soil vs. groundwater). As for pollution prevention, Peterson argued that these approaches are driven more by economics than they are regulations. In summary, he concluded that industry has eight generic needs with respect to demonstration and verification: a credible approach to verification; agreed upon performance standards (not just clean-up, but health and safety goals as well); regulatory flexibility, especially with regard to Records of Decision (RODs); testing with single-set protocols; access to federal sites for multiple demonstrations; information sharing and dissemination; a revamped liability system (i.e., tort reform); and reciprocity, especially with respect to permitting between and among states.

The next speaker was 3M's **Jack Evert**, who described his firm as a technology provider focusing in the environmental sector on materials development. He specifically referenced efforts to develop separation membranes to remove radionuclides from waste streams, and how his company's efforts to actually conduct tests under realistic field conditions have been constrained by potential health and safety risks. He concluded that risks such as these are manageable and that the government must begin to balance procedural requirements with risks associated with untreated wastes. Evert also spoke of the disconnect between technology developers and users; mentioned the downsides to conducting business as usual, as well as the upsides to risk-taking; and chided the Department of Energy (DOE) for its propensity to move technologies from R&D to full-scale prematurely. He urged greater emphasis on incremental technological advancements while addressing valid safety concerns.

Co-Chair **Grumbly** then asked participants how they felt about consolidating verification functions into some central organization, such as the Underwriter's Laboratory, and whether or not such an approach was plausible. **Patrice Kent** of the Yakama Indian Nation commented that such a centralized office must be credible for it to gain stakeholders' trust, and that it cannot be seen as an additional bureaucratic layer to what is already a complex process.

John Schofield of Thermatrix commented that California's AB 2060 Certification Program is a necessary and positive step in this area, and that the verification process is much more controllable at the state level. Schofield argued that federal agencies and regulators look to other states, particularly California, to see what is working. He cautioned the group about falling into the trap of citing regulatory barriers as the sole impediments to innovation. He urged the group instead to acknowledge flawed managerial approaches as principal reasons for business failures in the environmental technology marketplace. He also mentioned the Navy's Environmental Leadership Program and Texas' single permitter approach as real success stories in demonstration and verification.

Jim Allen, California Environmental Protection Agency (Cal/EPA), reported that the AB 2060 Certification Program is concluding its initial pilot stage, and in spite of the program's exemplary performance to date, argued against endorsement of a centralized verification capability/ authority. In short, Allen contended that verification is but one in a series of processes for securing a "stamp of approval" for innovative environmental technologies.

Gail Humphreys of the Community Environmental Council shifted the discussion to the plight of small businesses in the environmental technology marketplace, particularly their need for public and private funding sources. She highlighted the "Catch 33" situation where banks will not provide funding without a proven customer base, customers will not move on a given technology without a permit, and regulators will not issue permits without knowledge of the sites to be permitted. In response to this situation, she recommended that federal and state programs, small business development centers (SBDCs), and small businesses themselves focus on municipalities since they represent potentially excellent customers for innovative technologies. Specifically, she advocated a nationwide annual competition for partnering and demonstrating innovative technologies at municipal sites. Specific screening criteria (e.g., opportunities for innovative permitting, management team, peer review process, technology offered at cost, etc.) could be used to provide a low cost, shared financing approach to bringing environmental technologies to market. Winning proposers who successfully demonstrate will be attractive to private investors, and so might be proposal finalists who had excellent ideas but could not be selected due to funding limitations. She concluded her presentation by referencing the Community Reinvestment Act and speculating that it might prompt investment activity from lending companies.

Sherri Goodman, Department of Defense (DOD), spoke of the need for integrated demonstration and verification approaches, whether or not there is a centralized verification entity. Specific DOD programs making progress in these areas include: the Navy Environmental Leadership Program; Air Force Testing and Bioventing Protocols; interactions with Cal/EPA to develop protocols for verification and use technologies at military bases in California; and the Western Governors' Association (WGA) initiative to Develop On-site Innovative Technologies (DOIT) where ten installations are currently being used as industrial test sites. Goodman mentioned that DOD installation operations rival those of major industries in terms of pollutants generated and that pollution prevention is integral to facility management. As a user/polluter, DOD must focus on facility industrial processes as well as site clean-up. A key to DOD success in these areas, she

stressed, is an integrated system where users are able to efficiently and rapidly share data. The Interagency Environmental Technologies Office (IETO) is an excellent step in this direction.

Ray Robinson of Ray K. Robinson, Inc., focused his remarks on two generic types of demonstrations: physical problems (pollutants) and process problems. He argued that what may be needed most is a disciplined process to provide for verification. For example, industrial partners should be encouraged to work through a certain set of characterizations to generate innovative technologies and gain endorsement throughout the system. Because they provide the widest range of potential contaminants among federal clean-up programs, DOE environmental restoration and waste management sites can provide tremendous opportunities to demonstrate and verify holistic, systems-based clean-up approaches and secure performance-based measurements. Furthermore, private sector partners will increasingly share costs if demonstration and verification processes have efficacy.

Issue 2 - Stakeholder Involvement and State and Local Innovations

Co-Chair **Jim Souby** of the WGA shifted the roundtable discussion to the matters of stakeholder participation and state and local innovations. He claimed the DOIT partnership is capitalizing on opportunities to use federal facilities as test beds for demonstration and verification by selecting individual sites and technologies that match up with problem areas being confronted in the Western United States. Principal goals of this DOIT process are achieving better federal-state-stakeholder interaction, and promoting reciprocity for permitting (e.g., interstate and/or multi-state permitting). The bottom line requires bringing parties together to advance innovative technology use.

Jim Allen formally presented details of Cal/EPA's AB 2060 Certification Program. The program was created by state statute and initiated as a pilot program in early 1994. It is the first certification program in the country. Technology certifications are specific to scope of use; there are clearly defined requirements; individual technology certifications are of national/international peer review quality and worthy of regulatory compliance; and technology certifications are not limited to California companies. Such a process is integral to furthering environmental technology development. Acquiring California's "seal of approval" is widely viewed as a plus and promises to facilitate enhanced technology commercialization. The goal of this program is to simplify regulatory compliance. In furthering this goal, Cal/EPA will be developing regulations, requirements, guidance, and generic protocols as the process continues to move forward. Cal/EPA is also working closely with financiers in the state, primarily through the California Environmental Business Council. The longer term goal of AB 2060 is to promote multi-state acceptance of technology certifications. The Interstate Cooperation Group, working in cooperation with the U.S. Environmental Protection Agency (EPA), will contribute to these efforts.

Rick Locke, Pacific Northwest Laboratories, observed that there is value in promoting effective verification processes; however, he argued the current system provides little incentive to reward risk taking. He recommended the crafting of management processes and procedures that focus less on process and more on results.

Scott Bernstein of the Center for Neighborhood Technologies praised the California approach but recommended establishment of an accounting system that enables measurements of public policy goals (i.e., benchmarks that measure process-oriented accomplishments). With respect to information sharing, Bernstein commented that there is a compelling need to tie together data sets so that technology vendors have access to useful information. Finally, he made the point that no matter where verification resides, what is most needed is mustering public support for the process.

Patrice Kent acknowledged that the successful identification of affected stakeholders can be a difficult process but argued it is critical to ensuring all relevant concerns are met. Furthermore, early stakeholder involvement often leads to substantial progress in the beginning of the technology testing and demonstration phases and may ultimately determine public acceptance. Kent also spoke of the technical and administrative expertise of the Yakama Tribe and other Indian Nations, and how this expertise can influence federal-state-tribal interactions and agreements. In closing, Kent said that verification processes would be most acceptable to the Yakama and other Indian Nations if they were federally managed.

Ginger Schwartz of Ginger Schwartz and Associates spoke about the issue of public acceptance of technologies, providing a brief overview of the DOIT process and how it has been effective in securing broad stakeholder and public acceptance. She cited DOIT's eight principles of stakeholder involvement: early and frequent participation; timely access; clear definition of the involvement process; access to adequate technical expertise and financial resources; open decision-making processes; process documentation; process flexibility; and establishment of clear accountability. However, she stressed, strict adherence to these principles will not necessarily ensure public involvement. For there to be adequate stakeholder involvement in verification and demonstration, stakeholders must be a part of the process and share in government's decision-making role. Hence, government entities must not only embrace DOIT's eight principles but also make meaningful commitments to necessary institutional changes; internalize the stakeholder involvement ethic; and move from a process model to institutional reality.

Mike Driver of Patton Boggs focused his remarks on what needs to be done to build consensus within the 104th Congress under the leadership of the new Republican majority. Areas for major legislative emphasis might be risk assessment and linking health risks to health impacts. To accomplish this, the Clinton Administration and other public and private sector representatives participating in the Technology for a Sustainable Future (TSF) process need to have a clear sense of priorities and carry them forward to Congress.

Co-Chair **Tom Grumbly** commented on the need for a good set of recommendations regarding the verification process, focusing on at least one or two output-oriented approaches. In this way, government and industrial researchers can narrow the range of viable technology options. By bringing the problem holders and problem solvers together, we can begin to pursue technologies capable of securing public acceptance and environmental compliance/improvements.

Ray Robinson spoke of the need to focus on demonstration and verification needs, especially funding issues. Additionally, Robinson said that effective information dissemination is integral to both demonstration and verification. Since government is limited in how much it can contribute to the demonstration process, the private sector will need to do more. Robinson recommended that the federal government oversee the verification process, but that third-party review (e.g., state and local governments) is critical. As for permitting, greater reciprocity and flexibility for industry to seek process improvements and assume greater risks are essential.

Issue 3 - Enhanced Roles of Federal, State, and Local Governments

Shifting to the matter of the appropriate federal and state roles in demonstration and verification, **Robert Huggett** of the U.S. EPA spoke of the public's desire for action. Time is essentially money, and progress needs to be made. Huggett recommended the group focus on the following: demonstrations and the resources needed to fund them; verification and the need for credible data to underpin and verify technology capabilities and performance; and diffusion, particularly the repeated use and acceptance of technology through enabling verification processes. Regarding roles, he spoke of the need for government and the private sector to increasingly cost-share demonstrations. With respect to verification, he noted the need for some level of acceptance. A third-party verifier would appear to have the greatest potential for eliminating bias and winning public confidence. He added that reciprocity is essential and that permitting should continue to be state-based while encouraging increased acceptance and use of innovative technologies.

Mary Good of the U.S. Department of Commerce echoed Huggett's comments by stating that we need public acceptance (that it is a "given"), and that the public wants action and for government to control its costs. Thus, a total quality management (TQM) approach needs to be pursued to provide a competitive price, quality performance, and timely response. Incentives need to be created to encourage enhanced private sector performance and enable government partners to capture world markets. Presently, the United States is importing technologies that are, in many instances, superior to our own. Our goal is quite simple: the rapid development and diffusion of cost effective, credible, and innovative environmental technologies.

Co-Chair **Tom Grumbly** underscored that we need a greater sense of urgency in investigating new ideas and approaches that provide a single point for outputs (e.g., the Cal/EPA AB 2060 Program).

Cheryl Dobbins of Basic Technologies International cited the need to provide incentives to industry. In accomplishing this goal, government needs to expend increased time and effort in gaining a better grasp of industry's needs and "drivers." **Steven Gage** of the Cleveland Advanced Manufacturing Program noted the need to differentiate between control and site remediation approaches to verification on the one hand, and pollution prevention approaches on the other.

Iddo Wernick of the Rockefeller University said that there is considerable uncertainty regarding "what to verify" with respect to pollution prevention approaches. He also mentioned that rather than issuing new regulatory mandates, internally motivated benchmarking for pollution prevention is the optimal approach.

John Wilcynski, Idaho National Engineering Laboratory, commented that the demonstration process, at least from a site remediation perspective, often is not generating the desired outputs which technology users, regulators, and stakeholders are looking for. Increased contract reform holds the potential for reducing costs and increasing outputs. Furthermore, he recommended that national laboratories within the DOE system begin to break away from the traditional Management and Operations (M&O) role with respect to technology development and move increasingly toward purchasing remediation technologies from private industry. In short, there is enormous potential for innovation and the government needs to invest increasingly in technology development and provide the necessary assurances (e.g., greater government indemnification) with respect to potential liabilities spawned by these activities.

Roundtable Members

Industry:

Cheryl Dobbins, Basic Technologies International
Mike Driver, Patton Boggs
Jack Evert, 3M
Richard Locke, Pacific Northwest Laboratory
Linda Marvin, Lockheed Environmental Systems and Technology
Ralph Peterson, CH2M Hill
Ray Robinson, Ray Robinson, Inc.
John Schofield, Thermatrix, Inc.
Ginger Swartz, Swartz and Associates
John Wilcynski, Idaho National Engineering Laboratory

Academia:

Iddo Wernick, Rockefeller University

Non-Government Organizations:

Scott Berstein, Center for Neighborhood Technologies
Gail Humphreys, Community Environmental Council

State and Local:

James Allen, California Environmental Protection Agency
Stephen Gage, Cleveland Advanced Manufacturing Program
Patrice Kent, Yakama Indian Nation
James Souby, Western Governors' Association

Federal Agencies:

Mary Good, Department Commerce
Sherri Goodman, Department of Defense
Thomas Grumbly, Department of Energy
Robert Huggett, U.S. Environmental Protection Agency

Roundtable Support Team

Kevin Easley, Waste Policy Institute (WPI) (Prime Rapporteur)
Donna Goodrich, Department of Energy (Roundtable Planning)
Julie Leap, WPI (Assistant Rapporteur)

Roundtable 5
Finance

Co-Chairs: **Philip Lader, Administrator, Small Business Administration**
Dag Syrrist, Vice President, Technology Funding, Inc.

Roundtable Background

The investment community's interest in the innovative environmental technology market has largely been lackluster and the flow of venture capital limited, particularly in 1994. It has been said that the environmental industry "fears innovation and repels capital." This may be true, and if so, there are a number of reasons why venture capital remains largely disinterested. One of the principal reasons is the continuing uncertainty associated with an often complex and shifting regulatory structure. In addition, venture capital continues to flow where there is a potential for a high rate of return, or in other words, capital flows where it is treated best. Lastly, in many start-up companies, the absence of good corporate management skills and ill-defined business strategies also act as further deterrents to the flow of capital.

Summary of Key Issues and Suggested Actions

There is a tremendous degree of regulatory uncertainty and instability in the environmental market. Therefore:

- There needs to be a clear shift from a regulatory approach to one of performance verification (permit to audit).
- There needs to be experimentation with equivalency findings for performance verification.
- The federal government should scrutinize more closely the impact of all new regulations on business formation and growth.
- There is little agreement as to government's credibility in nurturing the environmental industry, except in the early R&D stages. However, there are useful models of later-stage government intervention which should be applied, e.g., an "Envirobank" small business investment corporation (SBIC) or an extension of an SBIC-leveraging equivalent to environmental technology investments.
- Certain Financial Accounting Standards Board (FASB) full-cost accounting standards and Securities and Exchange Commission (SEC) reporting requirements should be applied to create an economic incentive for individual companies to adopt efficiency standards.
- Though it is thought by some that the more we ask the tax system to accomplish, the less it will, certain targeted, revenue-neutral capital gains changes or investment tax credits could spur investment.
- In support of the Vice President's commitment to increase predictability in environmental regulations, the Clinton Administration, as part of the "reinventing government" initiative,

should select one or several geographic pilot projects to promote advances in regulatory certification.

Discussion Summary

Dag Syrrist, Technology Funding, Inc., noted that the financial community wants strong standards (predictable and enforceable) and flexibility in meeting those standards. Cost-effectiveness and competitiveness are ways to address the environmental industry and move the market forward in terms of economics. He argued that financing environmental technologies is not a "cash issue." There is not a shortage of capital; rather, the "valley of death" issue is a market symptom which is making people shift their capital elsewhere to earn a higher rate of return on their investments. Certainty creates market opportunity, equity opportunity will attract good management, and a rate of return will attract competition.

Philip Lader, Small Business Administration, pointed out that only some five percent of U.S. venture capital is in environmental technologies. Given the regulatory uncertainty and the available market capitalization, government can assist in several ways: Use systems, mechanisms, and funds already in place to provide for innovative leveraging in financing environmental technologies; give strong consideration to establishing an Envirobank; make the approximately 900 small business development centers across the country better appreciate the promise of the environmental technology industry and encourage them to provide technical assistance and play a role; and employ an Environmental Protection Fund, financed by small business polluting industries. He added that small business capital needs must be addressed as they represent over 50 percent of all private employment of the nation and 40 percent of the Gross National Product.

The Bank of America's **John Cromwell** said that commercial banks will get involved in financing emerging technologies only when there is a clearly-defined market, a clearly-defined market size, and a definable cash flow. The high technology industry has been supported by the venture capital community for over 20 years. Over this time, only five or six commercial banks have funded emerging companies. The commercial banks have been reluctant to invest in biotechnology firms because of the uncertainty associated with lengthy clinical trials. Determining when there will be a return on capital has been a key issue among investors. The environmental technology market is potentially enormous, but there is a need to define relevant market segments and, like the biotechnology market, determine how the commercial banks get repaid (clearer definition is needed in the application and approval process).

George Hatsopoulos of the Thermo Electron Corporation stated that technology commercialization "lessons learned" include the need for the existence of a predictable market and a stable market; entrepreneurship; and available capital. While these characteristics are common to many start-ups, a major characteristic which separates the environmental industry from other industries is the level of risk. He advocated creation of small businesses by large companies. In this manner, entrepreneurship and capital are linked and, in a best of both worlds scenario, you have a small company which can remain entrepreneurial while having the support systems of the larger company in place to deal with the administration, legal, and other "overhead" issues that are a tremendous burden to a new start-up, especially one that is dealing with the government. The small entity has additional "opportunities" in set-aside programs that the larger entity does not have and can attract business to share with the larger partner. It should be noted that the Department of Defense has such a program, known as the Mentor-Protegé program, where large defense companies receive credit for efforts in helping out small disadvantaged businesses. This principle could be applied in the environmental technology

development arena. Hatsopoulos noted that tax policies have a very real role to play (an adjustment in the capital gains tax has the potential to assist emerging high technology companies). Also, accounting policies (e.g., FASB, stock options) can have impacts on new businesses and the creation of economic growth.

John Preston, Massachusetts Institute of Technology, stated that the environmental industry needs to attract capital to invest in helping to bridge the "funding gap." By raising the tax on short-term capital gains and lowering it on long-term capital gains (i.e., revenue neutral change), the potential exists that this adjustment would lead to generating rather than shifting wealth. The federal government also has a clear role in helping to fill the funding gap, which the private sector is unwilling to fill, by providing funding at specific points along the commercialization pathway (e.g., at the pilot plant stage where the risk is too high for the private markets to take). Lastly, Preston noted that if a technology works to specification, this would simplify the regulatory process by shifting the risk away from auditing to permitting.

Jennifer Hernandez, Beveridge and Diamond, noted that with the medical technology industry, the market is both the primary driver and barrier. In the biotechnology industry, the market is the driver and the regulatory barrier is the Food and Drug Administration (FDA). In the environmental technology industry, regulations are both the primary barrier and the driver. Without a regulatory mechanism the environmental industry cannot succeed. The U.S. Environmental Protection Agency (EPA) is moving towards an audit environment, and now has the capability to implement "regulatory equivalency standards." Technology companies would have the opportunity to request from EPA a letter stating whether or not a technology is applicable to a particular problem. This would help companies to size the market in advance. And the investment community, knowing that an EPA letter is forthcoming, would obtain certainty.

Paul Inderbitzen, American Re-Insurance, expressed concern with respect to implementing the conference recommendations. What is needed, he argued, is a "feedback loop" to monitor and critique the process, preferably from the local level all the way to the White House. If we do not have evidence of success at the local level it is doubtful that the technology will progress further. We should consider having a multidisciplinary team observing the process at several sites around the country (as beta sites), perhaps in California and New Jersey.

Walter Howes of West End Partners stated that we need to focus less on punishing failure and more on rewarding performance. A capital gains tax could serve as an example of a macro-economic policy which could very quickly filter down to a micro-economic policy. A tax credit would quickly stimulate local market mechanisms and ultimately generate more entrepreneurship. Lastly, he recommended that consideration be given to turning remediation from a problem into a resource by using contaminated sites for test bed technologies.

Everett Ehrlich, Department of Commerce, stressed the need to focus more on adjusting the regulatory regime away from command and control and focus less on capital market deficiencies. He stated that tax policies may not be an effective instrument to solve the financing problems of the environmental industry. Finally, capital markets should be left to function on their own as the United States has the most sophisticated, liquid and segmented market in the world.

Modesto Maidique, Florida International University, stated that there are four success factors for new ventures:

- Market size: If it is large enough, it will offer opportunities (i.e., capital will go where it is treated best) and long-term regulations will help to create a market.

- Management and leadership: Certain corporate success factors must be present in new ventures to attract capital.

- A limited role of government: The primary focus should be on results.

- Financing: This is the least important factor. This is because if you have a market and stable regulations, capital will flow. There is little evidence that tax code "tinkering" will work.

The Bank of Boston's **Paul Hardiman** said that, in general, capital markets are not excited about the environmental market. What would help at this juncture is some form of governmental program. This could include: directing the Departments of Energy and Defense to focus on technology innovation; subsidizing large companies through tax incentives; and providing investment tax credits and accelerated write-offs. Collectively, these programs would draw greater action over time from the capital markets.

Jeffrey Leonard, Global Environment Fund, noted that the development of environmental technologies is a fine goal. But we should not confuse policy objectives with investment. Some have expressed their views that government is a "lousy" investment partner. We should not subsidize the commercialization of technologies. We should not be subsidizing the export of technologies because U.S. concerns are different from the environmental concerns of most of the world, where the focus is primarily on the application of basic environmental technologies.

Roundtable Members

Industry:

John Cromwell, Bank of America
Paul Hardiman, Bank of Boston
Shelley Harrison, Poly Ventures/Spacehab, Inc.
George Hatsopoulos, Thermo Electron Corporation
Jennifer Hernandez, Beveridge and Diamond
Walter Howes, West End Partners
Paul Inderbitzen, American Re-Insurance
Jeffrey Leonard, Global Environmental Fund
Sherman McCorkle, Technology Ventures Corporation
Kenneth Strong, Environmental Capital Corporation
Paul Zofnass, Environmental Financial Consulting Group, Inc.

Academia:

Modesto Maidique, Florida International University
John Preston, Massachusetts Institute of Technology

Non-Government Organizations:

Tony Carnavale, National Commission on Employment Policy
George Heaton, World Resources Institute

Federal Agencies:

Julie Belaga, Export-Import Bank of the United States
Everett Ehrlich, Department of Commerce
Harvey Himberg, Overseas Private Investment Corporation
Skip Johns, White House Office of Science and Technology Policy

Roundtable Support Team

Jim Ball, National Technology Transfer Center (Assistant Rapporteur)
Natalie Birke, Small Business Administration (Session Planning)
Richard Rogers, Waste Policy Institute (Rapporteur)

Roundtable 6
Education and Training

Co-Chairs: **Jim Baker, Administrator and Under Secretary for Oceans and Atmosphere, National Oceanic and Atmospheric Administration (NOAA), Department of Commerce**
Tom Malone, Director, Sigma Xi, The Scientific Research Society

Roundtable Background

This roundtable examined the general and specialized education and training needs and roles of institutions to support environmental educational and training. The U.S. educational system includes K–12, college, and graduate education; informal education at museums of science and industry; and life-long continuing education through business, community colleges, and telecommunications. These varied delivery mechanisms should be used to foster increased environmental awareness among consumers, to build technical and problem-solving skills in the workforce, and to spur creative invention in the field of environmental technology. Primary audiences for the infusion of new knowledge are student populations from elementary school through advanced graduate level, individuals who work for environmental technology firms, engineers and managers who work for the broad array of companies that use environmental technologies, and the general public.

Vice President Al Gore and chief executive officers of 25 U.S. companies met earlier in the morning to discuss ways that industry can contribute to the emerging National Environmental Technology Strategy. President Clinton participated in 15 minutes of the session and said he was encouraged by the CEO participation and the tremendous conference attendance. Strong commitment from industry is vital to the success of developing a sustainable national strategy.

In September at the Presidio of San Francisco, California, a Technology For a Sustainable Future workshop was held on environmental education and training. This workshop found that education about the environment is at a crossroads in the United States. The last 25 years have been spent promoting individual and societal responsibilities. But question marks remain as to whether the current culture is one in which sustainability and stewardship can be realized, and whether the necessary partnerships for an environmentally sound future are being built.

The purpose of the Presidio forum, attended by more than 100 persons, was to raise awareness of the need for education about the environment—education that is essential if sustainable development is to be achieved. The forum, which coincided with the formal transition of the Presidio from a U.S. Army base to a National Park devoted to environmental technology and education, generated discussion and debate among leaders in education, business, non-government organizations (NGOs), and government to: (1) underscore the need for partnerships; (2) take the first conceptual steps toward designing partnerships; and (3) affirm their commitment to act concerning the most promising ideas generated.

To help strengthen the federal infrastructure and increase the return on society's investment, the Clinton Administration has put in place a forward-looking framework for approaching environmental education and training. This framework is based on principles of quality, coordination, facilitation, partnerships, and sustainability.

Summary of Key Issues and Suggested Actions

The breakout session on "Education and Training" held the day before was well attended and stimulated lively discussion. Major issues addressed in the breakout session were:

- The use of life cycle analysis.
- Industry involvement in education.
- Community college involvement.
- Retraining the displaced workforce (e.g., defense workers).
- K–12, post-secondary, and workforce education.
- Internet education applications.
- Copernicus, a European program which coordinates technical higher education.

The main point from the breakout session was that the federal government needs to coordinate U.S. environmental education activities. A myriad of programs are "shooting stars," admired for their short life, yet with no on-going support these programs quickly fade away.

Co-Chair **Tom Malone** of Sigma Xi, in his opening remarks at the roundtable, said that we need to build on the trust which has been developed and create a whole new environment of cooperation. He expressed six principles which underpinned the discussions at the roundtable:

- Public support is absolutely essential.
- The stake of individuals needs clear identification.
- The common vision must include a society in which basic needs are fulfilled for generations to come, and where an equitable share of aspirations can be met for successive generations providing a healthy, physically attractive and biologically productive environment.
- There is a need to protect the privacy of knowledge discovered, integrated, disseminated, and applied.
- Partnerships are imperative among K–12, post-secondary institutions, professional societies, and national laboratories.
- Emerging new information technologies must be exploited to enhance environmental education.

Discussion Summary

The roundtable addressed five issues: (1) the range of environmental technology education needs, (2) the education and training needs of industry, (3) the role of universities, (4) the role of community colleges, and (5) ways to assist other countries.

Issue 1 - The Range of Environmental Technology Education Needs

In examining this issue, the roundtable members discussed ways to foster integrated systems approaches and multidisciplinary education from K–12 through universities; and ways to better prepare educators to teach environmental technology. The group recognized that environmental problems are highly complex. In the search for answers concerning these complex issues, it is clear that the current workforce lacks the patience and the skills needed to come up with equally complex solutions.

Sally Martin of the National Air Quality Center cited as valuable the "at risk youth education programs." However, finding jobs for these young people is a difficult challenge.

Georgia Tech's **John White** noted that the Department of Commerce's Malcolm Baldridge award focuses favorable public attention on quality and that a similar award with an environmental focus could help to educate all segments of society.

Joe Bordogna of the National Science Foundation is involved with an exchange program which helps industry and academia to understand the challenges facing both sectors. Another program, created by Bob Galvin, accelerated the teaching of total quality business and engineering. In this Motorola-sponsored program, called the "University Challenge," the firm hosted 100 engineering and business faculty members for a week to discuss Total Quality Management (TQM) within each engineering discipline. There is a need to take advantage of existing programs that have proven successful. An additional program of note is run by the American Institute of Chemical Engineers, which is progressively addressing economic and environmental issues.

Jack Weaver, Center for Waste Reduction Technologies, stressed the need to educate the whole population and not just scientists on how to behave. We need good basic education especially in science at the K–8 level. We need to educate the educators in basic science and environmental issues as well. Industry could participate at the high school level by providing real life examples.

Dennis Weaver, an actor, is the founder of the Institute for Ecolonomics, a non-profit, University of Colorado-affiliated organization that combines ecological issues with economics. Weaver, with Peter Jenkins, has created a masters degree program in "Ecolonomics." Many defense industry jobs were destroyed in Colorado and the Institute for Ecolonomics has been retraining this workforce for employment in the environmental technology industry. After obtaining basic business skills, these re-trained employees will have the potential to create their own businesses, or help corporations profit in environmentally sensitive ways. The Ecolonomics Center at the University of Colorado will serve as an "incubator" for inventors and innovators to see if new technologies are sound, make sense for the environment, and can be commercialized.

Issue 2 - Education and Training Needs of Industry

The discussion included treatment of new methods and innovative approaches being used by industry. For example, can concepts such as life cycle analysis and full cost accounting be better integrated into industry operating procedures?

Brad Allenby of AT&T introduced this issue by explaining that we understand remediation and compliance education but we really need industrial ecology and environmental design education which we do not understand at all.

A critical need, underscored Allenby, is to understand our ignorance as we face difficult issues. We need to change our education curricula so that business planners, engineers, process planners, and product designers are trained to use the fundamental methodologies or data needed to approach complex problems. In addition to asking what does industry need, we need to ask: "What can industry do?" We need to learn to partner effectively among government, industry, and academia. Industrial ecology is multidisciplinary and seeks to have engineers, managers, lawyers, and scientists talk to each other. It is time to "take the blinders off."

Allenby added that we can also take advantage of education opportunities through service industries. Ten percent of the U.S. population is served daily by McDonalds. Education programs for environmental literacy could target this market every day. There is also a need to restructure all levels of scholastic science awards so that special prizes are given to systems/interdisciplinary-based projects.

Bruce Piasecki of Rensselaer Polytechnic Institute noted that reeducation is needed. Scientists and engineers often have no patience in handling environmental liability, compliance, or product design issues. We need to reeducate our scientists, engineers, managers, and lawyers.

Edith Cecil, U.S. Environmental Training Institute, suggested that we take a global perspective and encourage industry to use training and education as a way to increase export of technologies.

Panelists commented that:

- U.S. industry was pro-environment until fairly recently when environmental protection came to be perceived as a threat to jobs.

- Thirty billion dollars is currently spent by industry on formal training and $180 billion on informal training, yet the most effective training is found in occupational training where people learn during the course of doing their jobs.

- Industry has an opportunity to help develop programs and tailor curricula to meet job requirements. It is essential to construct partnerships so that the technology community inserts technologies into curricula.

Tom Malone then brought up the issue of "dissemination of innovations" because small businesses do not have the resources to provide large training programs.

David Boon of Colorado's Front Range Community College observed that the U.S. Chamber of Commerce classifies 96 percent of its members as small businesses. There are over 900 Small Business Development Centers (SBDCs) in the United States which are often located at colleges and universities. The national laboratories could share information at trade association shows which are often attended by representatives of smaller businesses. The SBDCs could also provide Internet connections to the national laboratory databases. However, a great deal of the excellent national laboratory technology is far too expensive for American small businesses.

It was noted that trade associations often provide the only access that small businesses have to "big time" technologies; and that trade associations are working with the Environmental Defense Fund to solve point pollution problems in the printing and dry cleaning industry.

Lewis Reade, of the U.S.-Asia Environmental Partnership for International Development, described a project in his organization which helps small businesses to improve their relationship with the U.S. Environmental Protection Agency. This project targets companies that are too small for trade associations and have 10–100 employees.

The National Fish and Wildlife Foundation's **Maggie Bryant** stressed that the absolutely crucial need of small business is money. Government needs to substantiate loans better and help cut the red tape.

Issue 3 - The Role of Universities

Norm Christensen of Duke University introduced the issue of the role of universities in environmental education and training. How can we "green" engineering school curricula? Can we incorporate environmental awareness in other college-level courses? Christensen noted that dichotomies exist, e.g., research versus teaching, basic research versus applied research and basic scholarship versus applied scholarship. Five hundred years of departmentalization has not been ideal for environmental education. We need to implement change through a variety of strategies involving engineering, social science, basic science, and management strategies. There needs to be collaboration in order to produce a comprehensive strategy.

Jeff Berkuvitz of Community Innovations said we need to identify local community people from municipalities, hospitals, scouting organizations, and churches and bring them into community colleges for environmental training. We also need to integrate environmental education questions with sustainable development questions, community building issues and regional cooperation issues. His prescription is: Think big, start small, give people an opportunity to do what they can with what they have where they are. Only if we do that will we succeed at accomplishing our two goals of: (1) putting people at the heart of sustainable development and (2) getting public support for the important efforts at which we all want to succeed.

Other university-related issues include:

- We need to build upon existing university linkages/partnerships and form new ones.
- We need to prepare university instructors for multidisciplinary programs.
- How can we "green" all curricula in all programs (not just science and engineering)?
- How can we give scientific and engineering programs a dash of humanities?
- Ethics courses are needed too.

Issue 4 - The Role of Community Colleges

The role of community colleges in environmental education and training was introduced by **Paul Dickenson** of the Partnership for Environmental Technology Education (PETE). He stressed the need for a systems approach. There are six million credit students and six million non-credit students in the U.S. community college system. Many are minority students. Dickenson mentioned a workforce development plan advocated by the U.S. Secretary of Labor, Robert Reich, with regard to community college programs. It is essential to develop technician-level students who do the actual

field work. Their needs are different from those of professional scientists and engineers. "Hands-on" workers are critical. Efforts are necessary to better link the levels of elementary, secondary, and post-secondary education so that there is a clear pipeline in which to work.

Other community college matters were discussed:

- Community colleges provide excellent places for workforce retraining (e.g., retraining of aerospace workers, retraining at Rocky Flats, and the retraining of laid off petroleum and mining workers).

- Fifty percent of community college students already have degrees. Retraining should build upon and further the professional development of students.

- Community colleges can provide rapid response by providing flexible curricula. They can change more quickly than larger institutions.

- Entrepreneurs have very little capital and need short-term training to help them get their products to market.

- Community colleges can help to fill the gaps between science and public policy. They can help to advance scientific literacy and environmental justice.

- Small businesses can gain access to resources through community colleges. The community colleges can bring together players and disseminate information.

Issue 5 - Ways to Assist Other Countries

The discussion on assisting other countries with environmental education and training focused on ways to better share information, and on the special needs of developing nations. In introducing this topic, **Lewis Reade** said that the United States makes up only five percent of the world's population. Industrial countries including Europe and Japan make up 15 percent. Newly industrialized nations in Southeast Asia and Latin America comprise 10 percent. And countries transitioning from socialism or planned economies make up another 10 percent. Developing countries therefore make up 60 percent of the world.

Technician training tends to be better in foreign countries where the technicians are as highly regarded as fully qualified professionals. However, public awareness and mass media awareness is better in the United States. Unfortunately in East Asia, environmental concerns are seen in terms of costs and not benefits.

The United States can provide state and local access and support to students from abroad. America can share public education strategies and public awareness strategies. The U.S. private sector can provide education and training in cutting edge technologies. The United States also can share its sense of environmental community. Americans need to focus on long-term partnerships with foreign countries in order to achieve a high level of collaboration.

As we face the daunting problems and challenges ahead, it is important to remember that we do not have all the answers for foreign countries. They can help us as much as we can help them. A great foundation for international environmental education and training exists and we need to encourage even more sharing of information.

Co-Chair **Tom Malone** of Sigma Xi concluded the program with these points:

- A breakdown of education disciplines is encouraged. An integrated systems approach needs to be taught because environmental problems are complex and must take into consideration technical, regulatory, legal, management, and social issues.
- The federal government can provide a crucial coordination function with regard to environmental education and training.
- The federal government can a provide a modicum of funding support.
- Small businesses need access to innovations.
- The community college system is the fastest growing sector of educational institutions in the United States. Thus, it needs attention, especially for the minority student population.
- Good environmental education needs good basic science, but also humanities and ethics.
- Industry will play an important role in maintaining a global perspective.
- We must maintain a global perspective

Roundtable Members

Industry:

Brad Allenby, Research Vice President for Technology and Environment, AT&T
Jeff Berkuvitz, President, Community Innovations

Academia:

David Boon, Professor and Co-Chair, Environmental Science and Technology Department, Front Range Community College, Colorado
Norm Christensen, Dean of School of the Environment, Duke University
Jeffrey Leaf, Mechanical Engineer and Technology Teacher, Thomas Jefferson High School, Fairfax County, Virginia
Bruce Piasecki, Director, Environmental Management and Policy Program, Rensselaer Polytechnic Institute
John White, Dean of Engineering and Director, Center for Sustainable Technology, Georgia Institute of Technology

Non-Government Organizations:

Magalen Bryant, Chairman, National Fish and Wildlife Foundation
Tony Carnival, Chairman, National Commission for Employment Policy and Vice President, Committee for Economic Development
Edith Cecil, Executive Director, U.S. Environmental Training Institute
Paul Dickenson, Executive Director, Partnership for Environmental Technology Education
Tom Malone, Director, Sigma Xi, The Scientific Research Society, Research Triangle Park, North Carolina

Lewis Reade, Director General, U.S.-Asia Environmental Partnership for International Development (led by the U.S. Agency for International Development)
Dennis Weaver, Actor and Founder, Institute for Ecolonomics
Jack Weaver, Director, Center for Waste Reduction Technologies
Keith Wheeler, Executive Director, Global Environmental Education Network

State and Local:

Sally Martin, Executive Director, National Air Quality Center; representative to the Boulder City Council; and representative of the Southwestern States Public Recycling Program

Federal Agencies:

Jim Baker, Administrator and Under Secretary for Oceans and Atmosphere, National Oceanic and Atmospheric Administration (NOAA), Department of Commerce
Joseph Bordogna, Assistant Director for Engineering, National Science Foundation
Joseph Alexander, Deputy Assistant Administrator for Research and Development, U.S. Environmental Protection Agency

SECTION D

PLENARY ROUNDTABLE

DELIBERATIONS

Plenary Roundtable Deliberations

Chair: **Al Gore, Vice President of the United States of America**

Panelists:
Kofi Bota, Vice President for Research, Clark Atlanta University
Robert Bringer, Vice President for Environment, 3M
Charles Curtis, Under Secretary, U.S. Department of Energy
Bowman Cutter, Deputy Assistant to the President for Economic Policy, National Economic Council
Cheryl Dobbins, President, Basic Technologies International
Elizabeth Dowdeswell, Executive Director, United Nations Environment Programme
John Gibbons, Assistant to the President for Science and Technology
Dan Goldin, Administrator, National Aeronautics and Space Administration (NASA)
Mary Good, Under Secretary for Technology, Department of Commerce
Sherri Goodman, Deputy Under Secretary for Environmental Security, Department of Defense
Fred Hansen, Deputy Administrator, U.S. Environmental Protection Agency (EPA)
Paul Inderbitzin, President, American Re-Insurance
Philip Lader, Administrator, Small Business Administration (SBA)
Jonathan Lash, President, World Resources Institute
Katie McGinty, Deputy Assistant to the President, White House Office of Environmental Policy
Barry Naft, President and Chief Executive Officer, Dow Environmental, Inc.
Diana Natalicio, President, University of Texas at El Paso
Ralph Peterson, Chief Executive Officer, CH2M Hill
Frank Pope, General Partner, Technology Funding, Inc.
Richard Rominger, Deputy Secretary, U.S. Department of Agriculture
Ismail Serageldin, Vice President for Environmental Sustainable Development, World Bank
Sally Shelton, Assistant Administrator for Global Programs, U.S. Agency for International Development (USAID)
Martin Stein, Vice Chairman, BankAmerica Corporation
Maurice Strong, Chairman, Ontario Hydro
Timothy Wirth, Under Secretary for Global Affairs, Department of State

John Gibbons: One measure of dedication is how often you can get the Vice President involved in one meeting, and this is his third participation in two days. That is some measure of his dedication. Mr. Vice President, before we begin, I would like to thank you, on behalf of all the participants and organizers of this event, for your leadership in this very important area of public policy, environment and technology.

This morning at a White House breakfast with a smaller group, we were discussing a lot of ideas coming out of the conference and what might happen in the weeks and months ahead of us. EPA Administrator Carol Browner mentioned the possibility of getting out more of the information that EPA has about environmental technology success stories, in a sense a bulletin board for EPA. The Vice President mentioned that the Global Network for Environmental Technology (GNET) is up and running, and that many of you have signed up for GNET. In his usual way, he pondered about whether we should put EPA's bulletin board on GNET. Well, Mr. Vice President, GNET has now been linked with EPA's clean-up system providing environmental technology information to American industry. In addition, over 2,000 persons have now joined this conference via Internet. If you will look at the monitors around the four corners of the room, you will see the icon. Now we are in EPA's system through GNET.

Again, we want to thank you, Mr. Vice President and I will now turn the table over to you.

Vice President Gore: Thank you very much, Jack, to you and your staff. Thank you for all the hard work that has gone into this. I am going to be very brief because this a roundtable and we want to produce a lot of good ideas. I understand that the roundtable discussions preceding this one have been very lively and have generated a lot of excellent ideas. I look forward to hearing them this afternoon. The purpose of this Plenary Roundtable is to enable us to gain a better sense of the key elements of a National Environmental Technology Strategy. And, of course, by design this roundtable builds on the excellent work that was done in the 14 breakout sessions yesterday and the six roundtables that were held this morning. I want to thank all of you for participating in the events that have taken place here during the last couple of days, and also in the workshops around the country that preceded this conference. Your thoughtful contributions are critical to the development of a National Environmental Technology Strategy.

I asked the National Science and Technology Council, under Dr. Gibbons' leadership, to develop a strategy in time for release by next April's Earth Day which, of course, is the 25th anniversary of the first Earth Day. I asked him to go beyond the development of a federal strategy that looks only at the work of the federal agencies. Our country needs a truly national strategy, private and public, involving academia, non-governmental organizations, industry, and all elements of the public. Federal, state and local governments of course will be key participants with regard to the national strategy, and they can work together to advance these important technologies. The purpose of this White House Conference has been to discover and articulate the key ideas that ought to drive that strategy. I have five topics in mind for starters: (1) What is the overview of a long-range National Environmental Technology Strategy and how can we achieve it? (2) What are the economic and environmental opportunities from the perspective of industry? (3) What are the economic and environmental opportunities from the standpoint of the environmental community? (4) What are the opportunities for innovation in regulation and in finance? (5) How can we promote the application of environmental technologies worldwide? Turning to the first topic, what is an overview of a long-range National Environmental Technology Strategy and how can we achieve it? I think it is appropriate to start with Jack Gibbons on this first topic.

John Gibbons: I would like to kick it off by returning to something that you and the President stated early in 1993 in San Jose. You described our goal as simultaneously pursuing our environmental and economic objectives. These, rather than being in conflict, if we use our innovation, can be in concert. I do not think we can find a better way of expressing our overall intent -- we want to achieve long-term economic growth that creates jobs as well as profits and at the same time improves and sustains our environment. In other words, we are striving for sustainable development and we view

environmental technologies as the bridge to that sustainable future. In that future we see three things: (1) strong environmental standards strongly adhered to; (2) the freedom, indeed the requirement driven by free competition, to seek the most innovative, efficient and effective solutions to achieve those standards; and (3) partnerships between all of the stakeholders. This again underscores the partnership approach to solving problems that you and the President have so importantly stressed in the past.

Vice President Gore: Does anybody want to add to this discussion on the long-range vision or overview of what the strategy ought to be? Dan Goldin?

Dan Goldin: I would like to add to what Jack just said by saying there has to be education that comes along as a fourth element. Yesterday at the luncheon I talked about the fact that as a society we lack a biofeedback system, which you talked about in your book, both individually and as an entire society. As technology has moved along, our society has become more technologically illiterate. It is important that, as an element of our overall strategy, education play a major role, not just for the young people in schools, but for the entire population. What has happened with the environmental movement is that there is much mistrust based on ignorance. Data comes out and, because people do not understand it, we have a problem. For example, with regard to the problem with the ozone layer, a large group of people do not believe the data because of their lack of education. Education has to be an integral element of the long-range vision.

Vice President Gore: And of course there has been, with some, a willful disinformation campaign. But that is another topic.

Ismail Serageldin: Mr. Vice President, I would like to add that the long-term strategy being developed by the United States and the kind of vision that you are articulating here is going to have a profound impact on the rest of the world. Because the United States is the role model, it is the leader. It is the leader in free trade negotiations, technology, and in lifestyles that many people follow. There is a need for partnerships, not just in the United States, but between the United States and the rest of the world, between the industrialized countries and the developing countries. I believe that this first step of creating a consensus about the long-term vision or strategy for the United States will have a very beneficial impact for the world as a whole.

Diana Natalicio: I would like to pick up on Dan Goldin's comment about education. It seems to me that the challenge of trying to educate an entire population carries with it significant responsibility to achieve some sort of equity across all sectors of our society. I think one of our big challenges is to create an understanding among those who have in the past been underrepresented in science and engineering careers as well as in the environmental justice agenda. It seems to me that we have a rare opportunity here to create some very special opportunities for minority students, for example, to pursue environment-related careers and to help educate the communities from which they come. I would like to see within the environmental equity agenda not only attention to eliminating the degradation to the environment where minorities are concentrated, but also to engage the interest of young people from minority communities in environmental careers.

Charles Curtis: Mr. Vice President, I think we have all learned that private sector disciplines can improve the work of government and it certainly can improve this partnership that you are trying to form. Successful management depends on a focus on results, continuous innovation, and continuous improvement. I think that should be our overall strategy. To effect it is going to require building a common purpose between government and industry. That requires trust that industry, with that

common purpose, will produce results. If you can develop that trust factor at the core of the relationship, and I believe education does have a central role to play, then we can build the flexibility into the standard-setting that will allow industry to perform and nurture innovation, to sponsor competition in meeting our environmental challenge, and, frankly, to demonstrate a flexibility that will accept a lack of successful efforts from time to time. If we are really to develop environmental technology innovation, we must accept that the engine of success will at times produce failures. We have to comprehend that in our regulatory system. I do not think we have done a good enough job of doing that as yet.

Vice President Gore: This issue of trust is so important to the ability of our country to adopt the new model that everybody knows we need. Those of you here from the business community could play the key role in following up after this conference, not only on the specifics that are outlined in this strategy that will emerge, but also in following up on efforts to build that trust and to create the kind of dialogue that we need in our country. Because with dialogue all things are possible. Without it, it is very difficult to see how we get from here to there.

Elizabeth Dowdeswell: Mr. Vice President, I think a very important element of the long-term strategy has to be the contribution that the United States makes to the international policy dialogue as well, whether it is setting standards in international negotiations or creating the framework in which bilateral activities take place. It is very important that it not just be a transfer of technology but that industry and business actually be at the table during those negotiations. The Montreal Protocol, which deals with ozone depleting substances, is one of the best examples we have of how bringing industry and business to the table in the early stages can shape the nature of the agreement.

Robert Bringer: Mr. Vice President, in the parlance of today's looking to the future we often talk about reengineering, and I know you are familiar with that. In reengineering we often start out by looking at the way things are and the way things ought to be. I think the way things ought to be is sustainable development. I just want to make sure that, as we develop a long-term vision of environmental technology, we look to the future and not spend too much time in the past and the present.

Dan Goldin: I want to add one more point relative to long-term sustainability. This is an international issue, and I will give you a case in point. If we look just at regulations inside our own government, we may build the wrong products and bring them to market. Jet engine noise is an example. America sets standards; other countries set standards on oxides and nitrogen that come out of jet engines. If we set our own standards and then try and sell on a worldwide basis and fail to pre-coordinate the regulations worldwide, our corporations will be at a disadvantage in the world marketplace. So, if we want to look at long-term sustainable development, I think it is crucial that we understand the global nature of the marketplace and that certain regulations have to be dealt with. In fact, many of the aircraft companies have been working with NASA and the Federal Aviation Administration asking for our help not just technologically, but to help obtain a standard worldwide so, if they invest billions of dollars in a new product, the goal post will not be moved five, ten or fifteen years hence. I think that it is crucial if the corporations are going to have trust in the government to develop these new products and then make some money.

Maurice Strong: Yes, Mr. Vice President, building on that point I want to remind us all of the broader context. It is extremely important to all of us that those countries that are now moving on in terms of economic growth, largely in Asia and Africa, really have access to the best possible technologies. That means making technologies known to them, enabling them to acquire them, to use

them, to finance them. If they do not have access to technologies, and if they do not use them, all of us are going to be saddled with the environmental impacts. There is a real coincidence between the immense opportunity for U.S. environmental technology and the global requirement that those technologies be used.

Sally Shelton: If I may add to Maurice Strong's and Dan Goldin's comments, I guess we sort of segued into international market development. At USAID we are seeing extraordinarily strong growth in markets for U.S. industry in developing countries. Between 1990 and 1993 alone, exports to developing countries grew by 50 percent as contrasted by growth of about six percent to developed countries. We are estimating that, worldwide, developing country expenditures on environmental technology will roughly grow twice as fast as the rate of growth of expenditures on environmental technology of the developed nations. So, there are enormous opportunities here, not only for U.S. industry, but also for the U.S. Government to ensure that we are working closely with the developing countries in shaping the appropriate environmental framework. Many developing countries where USAID is involved are very anxious to shape environmental regulations, to be very blunt, so that they are consistent with U.S. standards and so that they can use U.S. technology. So, I think there is a really important role to play as we look toward the future at how we can work together in partnerships. Whoever mentioned non-governmental organizations (NGOs) was absolutely right because it is critical to develop a partnership between business and government. But it is also critical to have the NGOs as part of that partnership. They have been extremely important players, along with the U.S. Government and U.S. industry, in working with a variety of countries whose future is going to be very important for U.S. industry.

Vice President Gore: We just completed three days at the Summit of the Americas in Miami with 34 countries from our hemisphere represented. One of the three principal topics was sustainable development, and the NGO community was extremely helpful in producing the consensus there.

Katie McGinty: With regard to the technology, we are talking about looking into the future. Let us remember to look at software in addition to hardware, and at new ideas about processing. In terms of process technologies, if we look at things like industrial ecology, sometimes that focuses too much on what kind of widgets we can use to clean up things. But more importantly, how can we look at the whole production system? How can we reengineer the production process itself, so that, for example, we are not producing the things that need to be cleaned up at the end of the pipeline? This is something that in our engineering schools and in our manufacturing centers has received less attention. My understanding is that production engineers are not typically the ones that are given the spotlight in our manufacturing centers or in our universities. If we can focus some increased attention here, we could prevent pollution at the front end as well as develop the new technologies that can help to clean it up in a more effective and cost-effective way.

Richard Rominger: I would like to stress the importance of environmental technology in agriculture. As the population of the world continues to increase, we are going to be called upon to produce more food and fiber. We are not producing any more land, so we have to do a better job in making sure that we do not degrade any more of the earth's soils. We have already seen too much of the world's soil degraded. We have to make sure that we are developing technologies with our farmers and working with others in the private sector and the land grant universities so that we can have a sustainable agriculture. We are making some headway with conservation tillage and, looking long range, we are examining engineered plants that contain their own pest and disease resistance. But, we have got to make sure that we keep that capability there and work on those kinds of technologies.

Barry Naft: I agree with Katie McGinty. In addition to our remediation technologies, there is, from our viewpoint as a service provider, a growing need and demand for a number of technologies used in what we call strategic chemical management. These involve a number of disciplines which are not so traditional to the environmental services industry but still are growing in their importance with regard to sustainable development in the strategies of a number of countries and multinational companies around the world. I think we need to place greater emphasis on this area when we talk about developing our technological profiles, because the United States has excellent capabilities and can be a global leader in this regard.

Vice President Gore: Well, thank you. I am going to propose that we now look at the economic and environmental opportunities from the industry perspective. To summarize on this first topic, our long-range vision for environmental technology is that we have to have a national strategy that recognizes the economic benefits in terms of a higher standard of living, jobs for American working men and women, and identifies environmental technologies as the bridge to sustainable development. In the process, we need to stress the importance of shifting to an avoidance paradigm or a prevention paradigm, and look at process engineering and the whole impact of the technology in question.

It may sound a little too sweeping to assert this, but I honestly believe we are in the midst of a philosophical shift in our civilization, away from single-cause, single-effect analyses and toward a systems analysis approach that looks at the complete life-cycle of a product, that looks at a process from the origin of the natural resources to the ultimate disposal of the waste products and opportunities for recycling in between. We have to have a strategy that emphasizes that approach in the development of environmental technology.

We have to identify partnerships as building blocks for the strategy if it is to be successful. That means we have to pay attention to the creation and nurturing of the partnerships, and to the perspectives of the different stakeholders and players. How do we harmonize our goals, develop a shared vision and communicate about the values that we are going to apply to decisions in industry, in the NGO community, in government and in every other sector of the partnership?

And finally, our long-range vision has to emphasize innovation as a key element in R&D, commercialization, regulation, finance, and education and training. Next April we will have absorbed all of the comments that have been made during this conference to the maximum extent possible and we will articulate our vision of what a fully detailed strategy for environmental technology ought to be. Now, our second topic is, what are the economic and environmental opportunities for this strategy from the industry perspective? I am going to call on Ralph Peterson to kick this discussion off.

Ralph Peterson: Thank you Mr. Vice President. I guess if there is one conclusion that stands out most strongly from our last two days, it is the inescapable notion that the concept of sustainable development and the technology that underpins that sustainable development is really quickly emerging. It is the key economic foundation, the key underpinning that is going to define the basis of competitive advantage for companies and for countries at a rapidly accelerating pace in the future. As we reflect on the dual pressures of population growth and the level of economic and industrial development that is likely to occur to raise standards of living, not just here, but in the developing countries, and as we layer in the notion of the dropping trade barriers and the increasingly global nature of sourcing for all manner of supplies and goods and services, we very quickly come to the conclusion that this issue of sustainable development, and the technology and innovation by which it

gets advanced, is going to be the basis by which companies and nations compete in the future. So, this, more than anything else, becomes, from an industry perspective, a matter of competitiveness. It is not an if, but when, and it is not an option, because we will either make the changes we need to make to respond to how things are going to get done, the better ways, the better environmental stewardship and the union of economic and environmental interest, or we will be displaced in the marketplace by those who have adjusted better.

I am also heartened by the partnerships that have emerged as good opportunities here. I like the notions of moving beyond the adversarial relationships that, frankly, have needlessly divided us, to try to hammer out better working relationships, to pursue our common goals with regard to that melding of the economic and environmental relationships that you talked about. I have never been more encouraged about the possibility of seeing that unfold in a real way. There is a lot of evidence that it is happening already.

Finally, I think the platform is set for innovation in some very new ways. I am thinking about the Rapid Commercialization Initiative that you announced yesterday. EPA Administrator Carol Browner announced some new demonstration techniques and technologies. There are some ideas for regulatory enhancement and revisions that, I think, will help us synchronize the regulatory issues, advance innovation, and facilitate partnerships.

Martin Stein: Mr. Vice President, I would like to second Ralph's remarks. I am very encouraged by what I have heard over the past few days. I think there is an enormous economic opportunity, and the partnership idea to remove what at times has been a confrontational relationship is critical. I would add, however, that we have a unique time window here. It is very important that we do this quickly. While I have heard some excellent ideas about how the federal government should change, I challenge my private sector colleagues to talk about how we can change so we can add to the process.

Vice President Gore: I certainly want to encourage that line of thinking. You find that in other countries that have made more progress than we have in approaching this question there is a different tone to the dialogue on the part of the business participants. Despite considerable dialogue, we still have a lot of dissidence with deep divisions within the general business community. The environmental technology part of the business community is, by and large, one of the most progressive voices that I hear. A great many Fortune 500 firms have done thorough analyses and are anxious to meet and exceed the standards. Many very creative small businesses and medium-sized businesses have the same point of view. Some other businesses, however, express a completely different point of view. If there was some way for those in the business community who are here attending this conference, and others that you know about who feel the same way, to organize that progressive voice more effectively, to have a bigger say when these issues are debated, it could certainly make it a lot easier to build that trust level that we talked about earlier and to make the dialogue between government, business, the NGO community, and local and state governments much more productive and helpful.

Frank Pope: Mr. Vice President, along those lines, we concur that responsible industry has to take charge and make its position known. We do not want to back down regarding standards, but, one of the things that came up at breakfast and a few other places is the deep distrust. How do we take care of the half that is not going to act responsibly? One of the suggestions that has come up is to set up a regulatory path that, in fact, rewards people who are willing to go beyond compliance and take a stand.

For example, you can set up regulation similar to some of the five-star programs of the Occupational Safety and Health Administration (OSHA) where, if you commit to going beyond compliance, you will have a performance standard you have to meet. Maybe you are audited on that performance standard as opposed to the control method, where you are told what to do and have to get a permit to do it. You would be given a little more flexibility in trying innovative ideas because you would at least be making the best effort in good faith. Quite frankly, people who do not want to take that stand can fall under the control format we already have. If they want to battle that out, that is great. Most of U.S. industry that we have talked to wants to move forward and wants to get the job done. They are just tired of the gridlock.

Vice President Gore: Well, we are definitely heading as quickly as we can down that road. We need the help of you personally and of the business community that you represent. We have a window of opportunity to make that transition that we are talking about here. We are pursuing this vigorously.

Barry Naft: There are really two sides to this discussion. One is the manufacturing sector and how it can benefit from these technologies. The other is the services sector and how it can use these technologies to expand its business, especially globally. I guess I can wear two hats here. Dow, being one of the 20 largest industrials in the country, is dedicated to sustainable development. I see a large and a growing number of our peers embracing this concept as well. The reason is that it is good business. Look at the payback for the investments made, in terms of waste minimization and pollution prevention, and they score very high in the range of ways to spend corporate capital. I think this will continue to be the case. I am not sure that the U.S. business community is aware of its need to be vocal in this regard and to support this position with political activism.

From the other side, with regard to the service providers, I have been to the five continents in the last three months and talked to a lot of people. I can report back to you that U.S. technology is held in very high regard. People like it, they would like to use it, and they would like to partner with us in using it. U.S. regulation is very well focused in their minds, and that gives them encouragement to work with us. I think the future looks very bright in that regard, although the services industry in the United States does have some valuable lessons to learn in how to be a competitive player on a local level in the international community.

Cheryl Dobbins: Mr. Vice President, I think it is important that small businesses be included in the mix. As a part of that, we really have to look at making it conducive for them to take the risk to develop and employ technologies. A part of the reason why small businesses do not take the risk is because they do not get the same kind of information that Fortune 500 companies get. We truly have got to level the playing field in terms of access to information and dissemination of that information to small and micro-businesses -- including to those small businesses that generally make up that backsliding group that we talked about this morning.

Vice President Gore: GNET ought to be a major means of making information available to small businesses.

Cheryl Dobbins: Yes, and GNET has to reach out to those businesses, and it has to be accessible to them.

Vice President Gore: Even though not everyone is using the Internet, usage is growing rapidly. It is pretty cheap and pretty easy to get access to. Your point is an excellent one and we ought to pursue it.

Robert Bringer: Mr. Vice President, I think your concern about those who have the understanding and those who do not or refuse to see it will be taken care of in the long run by competition. We are spending about 20 percent of our R&D budget of about a billion dollars a year, about 200 million dollars on the development of clean products and clean processes. We feel that is not only the key to an improved environment in the future, but it is also the key to our being competitive in the 21st century. We have found that the cleanest products are also those that have the highest quality, lowest cost and greatest marketability. So I think it is key for all companies to recognize, sooner or later, that they need to get on this bandwagon and to move into a more positive mode relative to environmental technology. We have also seen the shift to more sustainable processes resulting in some very unexpected product innovations, things that we really did not anticipate when we moved into this mode.

Vice President Gore: I recall that 3M created the "Pollution Prevention Pays" program early on.

Robert Bringer: That is right. Just about 20 years ago.

Frank Pope: In talking about opportunities in the venture capital communities, a comment was made at one of the roundtables that most of the good opportunities do not exist just because of the focus on end-of-the pipe technologies. We believe that there are enormous technical resources already in existence, as Mr. Bringer has suggested, and we know that at Dow, for example, they spend millions, hundreds of millions, of dollars developing environmental technologies. One of the challenges is that these technologies do not get commercialized. Instead, they get used internally to solve problems. These companies, with some exceptions, are not interested in being in the environmental business. One of the challenges we face is finding those technologies and pooling resources together. It is an opportunity for entrepreneurs to then go out and commercialize these things, and to make them available to the general industrial community. This is where we are going to see an awful lot of our development. But we have to figure out how to get entrepreneurs into those operations and start those third-party provider businesses. Right now it is being done in-house by people who really do not want to do it in-house.

Ismail Serageldin: Mr. Vice President, there are two points that I would like to add to this discussion. First, I want to note the incentives structures and the creation, for example, of markets for the adoption for new technologies, permits, and other sort of title permits in the United States.

Secondly, I want to emphasize the importance of the growing export market for these technologies. Last year, the World Bank alone put more than 2.5 billion dollars in environmental technologies, over 1.5 billion of which is going to developing countries to purchase technologies and that is available for international competitive bidding. There are two kinds of technologies. In the Far East it is new technologies because the economic growth is so fast that there is investment in new plants and there is a lot of partnership going on. In Eastern Europe and the former Soviet Union the technology involves a lot of retrofitting of existing plants and facilities because the economies are not growing that fast. Therefore, the investment must be there. In all those places, people are looking to U.S. technologies as being the cutting edge.

Vice President Gore: I want to ask Phil Lader to address the industry perspective from the viewpoint of small business where so much of the innovation takes place. We have heard from some in the small business community already, but Phil, as head of the SBA, has a unique perspective on this.

Phil Lader: As several of the previous commentators suggested, and as many of the speakers in the earlier roundtables have made clear, there is an incredible interweaving of regulatory issues and financing issues for all businesses, particularly for small businesses. When it is said that the most common characteristics of successful commercialization of technologies would be a stable and predictable market, the right entrepreneur, and a terrific technology, surprisingly, most of the venture capitalists and entrepreneurs say that the last, the technology, is the easiest to gain in that mix. The most difficult to achieve is the stable and predictable market in which to operate and, consequently, the whole regulatory framework. The shift from a regulatory approach to performance verification is very important, as a financing mechanism, to small businesses. There are hundreds and thousands of small businesses already successful. If we want real innovation, that is going to be the heart of it.

Sherri Goodman: The Department of Defense has made a special effort to reach out to small businesses. Coming out next month is a special set of materials that will be both on the Internet and in hard copy on, "*How To Do Environmental Business With the Department of Defense for Small Businesses.*" It will be widely available. I have made extra efforts to work with the small business community because it is an important part of our effort.

I believe a model for what we are trying to do here lies in the successful effort you led last year in acquisition reform, where we said, essentially, we build the best military capabilities in the world and we want to continue to do so. But, there are some problems in the process. It is too cumbersome. The same is somewhat true in the environmental area. We have the opportunities to make some real differences here to focus more on the performance standards that we need to achieve a certain goal instead of how we get there. The technologies can help us do that, and our partnerships in industry are very important.

In the Department of Defense, we are working with industry in the pollution prevention area, extremely important because we are an on-going business. We look at things such as how to take paint off aircraft and ships so it is not toxic. In the future, we should be looking at not just how to change that process, but, as Katie said, maybe we do not need to paint in the future. We should be looking at the very process itself or the material. We also partner with chemical and oil companies where we are problem holders, for example, of major remediation concerns. We are working to bring industry in and use our military bases as test sites. This will enable us, in partnership with industry, states and other stakeholders, to understand and develop new hardware and software and new permitting and other processes to move this along.

Vice President Gore: I certainly agree. One of the examples I have often used, simply because I saw it with my own eyes in Nashville, Tennessee, is the company, Northern Telecom, that tried hard to be the very first company in its industry to completely eliminate chlorofluorocarbons (CFCs). They set a date, a deadline many years out, and committed themselves to completely eliminate CFCs. They used them in cleaning circuit boards, making telephones and other instruments. They committed themselves absolutely even though they had no idea how they were going to meet the goal. But, they engaged the energy and creativity of the men and women in the company and they started seeing people really get involved, and come in early and stay late and come in on weekends to work this problem. They began to ask different questions along the lines you suggested with the paint example.

They said, "What do we use these CFCs for?" It was to clean the circuit boards. Taking a more creative approach, they asked a second-order question, "How do the circuit boards get dirty in the first place?" And, "How can we change the process to avoid not just the pollution that comes from the cleansing, but to avoid the need to clean them at all?" They developed a no-clean process which not only completely eliminated the use of CFCs, but produced, as is often the case, a higher quality product at a cheaper cost. They came to dominate that particular process in their industry, had the patents, and achieved a tremendous gain.

Goethe once wrote something to the effect that "when one commits oneself, in that moment all providence moves also." I believe there really is a lot to that. Time after time you see companies that decide to take on a challenge that is a little bit outside the narrow borders of what the P&L statement will frame up. They take on a little larger question. All of a sudden they find that they have more to work with than they thought because the people that work for them take pride in trying to solve the larger question. They end up making a lot more money in the process.

I think it was Michael Porter who wrote the book about taking on the challenge of meeting tough but sensibly constructed environmental standards. It turns out time and again to be a tremendous competitive advantage because the companies that meet the challenge end up being leaner, tougher, and more creative, better with higher quality and lower cost. To some, unfortunately, that sounds counterintuitive, but in the real world, and we hear it from so many participants in this roundtable, in the real world it actually works that way.

Mary Good: I wanted to add one point to the small business piece. Our manufacturing extension program is now beginning to provide environmental support for small businesses. If we calculate the value that those centers are bringing from the dollars that they can save in their environmental efforts, it turns out to be one of the big contributors to the overall value of those manufacturing extension services. Part of that has been done in concert with the SBA.

A very telling point was made this morning in our roundtable. It had to do with businesses that supply environmental products and services. There is a certain urgency at this point in time because we have all heard about these wonderful environmental markets that are emerging all over the world. We need to be in a position to begin to fill those markets. The question came up about siting demonstration projects so people can actually demonstrate their technologies and get verification of the results. Clearly the Rapid Commercialization Initiative that you announced yesterday is a small piece of this whole discussion, but it is kind of a nice one because it is something we can do, we can do it quickly and we can actually get results at the end. This should be very promising.

Vice President Gore: Very good. I want to ask Jonathan Lash to address the same general question from the environmental NGO perspective. What are the economic and environmental opportunities involved here?

Jonathan Lash: I think you probably seated me too close to Ralph Peterson because I find myself in almost complete agreement with him and with Frank Pope. In fact, I think that over the past day and a half, we have had startlingly broad agreement throughout this conference among all 1,400 people who have been participating on five important points. First, the development of environmental technologies offers enormous opportunities for combined economic and environmental benefits, and, indeed, technology is the only way we can achieve sustainable development goals. Second, in order to achieve progress in environmental technologies, we need to engage the entrepreneurial energy, inventiveness and creativity of the industrial sector and the interest of the finance sector. Third, in

order to do so, one key element in the strategy has to be to create a reliable expectation that success will be rewarded with profits, that it will be profitable to be green and it will be even more profitable to be greener in smarter ways. Fourth, the regulatory system which can be used to push technology is, far more often in fact, a rigid obstacle to technological progress for environmentally beneficial technologies. Finally, there is a startling willingness among this group, among government, industry, and environmental organizations, to move to a post-regulatory strategy putting our incentives where our objectives are. But, that kind of change entails significant risks for all three sectors and significant difficulties.

There is a real question how to begin, and I would like to make a small proposal building on what Frank Pope said. I think there is a unique opportunity right now for us to set up a very ambitious demonstration program that goes well beyond the OSHA Star program. It would allow industries to self-select, to participate in demonstrations in which they would agree on ten-year goals that go significantly beyond the environmental benefits of current standards. In return they would get a guarantee of stability and flexibility. This is not just a few inspections that do not take place. This is real freedom from the command and control system. The industries would get a system in which there are periodic evaluations by milestones that are set very publicly. There would be a sort of "trust but verify" system in which EPA sets up a management advisory committee to oversee the process. All parties would have a chance to assure themselves that this process is for real. This process would enable us to go much further than with the current command and control system. I cannot think of any time in the past 20 years when that opportunity has existed the way it does for us now.

Vice President Gore: Well, that is a good idea. Fred Hansen, what about addressing this question? What are the opportunities for this kind of innovation in regulation? We are all for it and there is a lot of support for it. We have had a lot of extensive discussions in the White House about how to get there from here. We have identified many practical obstacles. Trust again is the key issue. What is your view?

Fred Hansen: Jonathan Lash's proposal makes a lot of sense. I think it goes back to your observation, Mr. Vice President, that we are moving away from the single cause to the single result, and looking at things in a systemic way. Certainly within the environmental regulatory field, we have found ourselves historically acting pollutant by pollutant and industry by industry, with a command and control approach. Now we find, as Jonathan and everybody else around the table has noted, that those are the roadblocks. How can we move beyond that? I think there are four important pieces of what we need to be able to do in our regulatory framework. One, we need to be performance-based, meaning we need to find more approaches where, in fact, we are able to set the standards but not the methodology of getting there. Two, we need to have flexibility, again, that ensures that we achieve the end results, but that we do not dictate what the means are. Three, we need to reward with incentives, i.e., go beyond compliance. And lastly, we need to establish effective partnerships with all the stakeholders.

One quick example captures what we can achieve. One of the nation's largest high-tech computer companies, after the 1990 Clean Air Act, was questioning whether it would ever have another new manufacturing job on shore. EPA and my home state, Oregon, entered into a partnership with that company to put together a permit that -- although it is still in the draft stages -- really is pre-approving certain processes to take the time constraints out of the permitting effort. Where the permitting effort might have taken 18 to 24 months before, roughly the time that it required that company to move that product to development to market, we were able to move ahead. Those are the

types of real concrete things that I think we need to advance in a whole array of approaches. We are committed to doing so.

Vice President Gore: That is great. I want all the participants here to know that we have a vigorous and active process in the White House on these possibilities. The Office of Environmental Policy has had this process going for almost a full year. The Office of Management and Budget has been deeply involved in a broader overlapping area for quite some time. I have been asked by the President to direct this process. Jack Gibbons is deeply involved in the areas of risk analysis and regulation and we have more than a dozen task forces working with a short timetable. We are very optimistic that we can present the President with some options very soon that will look similar to what Jonathan Lash, Fred Hansen and others are talking about. Now I want to ask Frank Pope to say a word about new opportunities for making capital available and how they might be related to the kind of approach that Fred Hansen and Jonathan Lash are recommending where regulation is concerned.

Frank Pope: I think, Mr. Vice President, you have to understand, and I think you do, that generally capital actually is a follower and not a leader. It is pretty straight forward. If we cannot make money, we will not come. I am not paid to lose money or to be socially good. The reality is that we have to make this business profitable. We have to create an industry where we can demonstrate that environmental technologies can make money. That has not happened to date. I think there are some good opportunities coming up and, if we make a shift here, even enormous opportunities. You have held out the olive branch about releasing some of the control. The venture capital community is very adept at dealing with competitive issues.

Can our technology be more economic? We would like to deliver more economic solutions to our customers. We hate dealing with arbitrary mandates since they typically are not economic, not cheaper, not better, and not faster. They sometimes come out of the blue, and we do not know how to deal with them. There is too much unpredictability. What we have to do is try to make the path to commercializing environmental technologies shorter and more predictable. One of the things to come out of this conference that I am greatly appreciative of is the Rapid Commercialization Initiative. The emphasis has been on commercialization. The problem here is not development, nor creating technologies. The problem is how do we get technology out of development and into the hands of users so they can buy it, produce it and make some money on it? This has been where all the obstacles come in. It is the one element that we see in the environmental technology area that is different from every other business. And this is one of the reasons why the venture capital community in general has not been particularly enthusiastic about environmental technology. The big shift we need to see is from internal development to external suppliers. I think to some extent we are starting to see that happen. Opportunities will abound in the environmental technology market but we have got to make it easier.

Vice President Gore: This is very encouraging. Before I leave I want to call on my friend and long-time partner in environmental issues, Tim Wirth, to revisit some of the topics that we touched upon earlier, including the tremendous opportunities worldwide, how they relate to the ability to raise capital, and ways to gain more attention for these industries.

Tim Wirth: Thank you Mr. Vice President. Before getting to that part, let me just follow up a bit on what Frank had to say and pick up on the President's Council on Sustainable Development. You urged that council some months ago to think boldly. We are now in an environment in which we can think very boldly from a public policy perspective, as Jonathan was talking about, about a different ten-year regulatory pattern. I think there are other areas where we can insist on a regime of really

getting the prices right and going to the Congress and talking about subsidies. We can talk about an accounting system that is a real accounting system and is not missing a lot of variables. We can pick up on what Bill Archer is talking about in terms of maybe talking differently about taxes and focusing on a tax shift where we are rewarding and punishing different things. We could be rewarding capital and rewarding labor rather than the other way around. There are some wonderful opportunities.

Let me turn now to the international framework for making this happen. First, from a policy perspective, at the risk of stating the obvious, there clearly has been a major shift in the way in which our government and our country are viewing foreign policy, moving from containment to some new models, one of which is very obviously a promotion of economics in trade, front and center. Containment of Communism is behind us and now international trade issues are loud and clear. Second, we are attempting to change our institutions to be responsive, for example, having our embassies be platforms for trade assistance. We are changing USAID where Brian Atwood is focusing on sustainable development. We have a great opportunity to change international financial institutions. We cannot do that without the resources. In a way, what we are talking about here is all of us sharing a vision of a sustainable future. I think that we are going to have a major job to be sure that the support is there for the World Bank, for the international financial institutions, and for USAID as the Agency rethinks itself -- because those are very, very necessary partnerships. Let us hope that all of the energy and commitment in this room can help to sell technology for a sustainable future to, what is in many cases, a doubting world out there. We have to reshape our institutions and our thinking to become more sustainable.

Vice President Gore: Well, thank you very much. I am going to have to leave before the conclusion of this roundtable. I will look forward to getting a full report on the rest of it. I do want to say one more time before I leave how grateful I am and how grateful President Clinton is to each and every one of you for taking part in this important process which is absolutely critical. The current way our country approaches the overall subject of environmental technology is less than ideal. To make a process engineering analogy it is often sloppy and wasteful. We have unnecessary transaction costs, and we spend a lot of time on things that do not produce many results. We miss a lot of opportunities. We are not as efficient as we should be. Thus, taking the time as a nation to really think though how we are going about this is critically important. And this process, in turn, fits into the larger matters that have to be addressed, i.e., the profit opportunities, U.S. leadership, and how we address the environmental consequences of the current way we are doing things. This is a radical shift in the relationship between humankind and the ecological system of the earth.

As we try to address the population problem sensitively and appropriately, we have to also recognize that technologies that magnify the impact of each individual on the earth have brought many blessings but have also brought many unwanted side effects And when you multiply 5.5 billion people times the tremendously powerful impact of all these new technologies, you get an overall impact that is entirely and completely unsustainable. And part of the solution is to create the incentives, structures, partnerships, and vision that will make it possible to bring to the service of humankind, to each and every one of us, a new set of technologies that accomplish the results we desire in life while having less impact on the environment -- and simultaneously with less expense and with greater efficiency. We know basically how to go about this but putting all the pieces

together and coordinating a National Environmental Technology Strategy is a vast undertaking. Jack, thank you for leading this charge. And to all of you on the roundtable, thank you. Please allow me to

depart without interrupting the flow of the conversation which I now will turn over to Jack Gibbons. Thank you all very much.

John Gibbons: Let us hear now from Bow Cutter.

Bow Cutter: I wanted to make a systems summary and ask Jonathan for an expansion of his suggestion. In a way, what has been said around this table and what has been said for the last couple of days in this conference as a whole is that we have a glimmer of a system that works. We know that the previous system in a sense consisted of the following elements: environmental services often being provided for essentially internal use; technologies being captive because they would be more or less devised for specific cases; and command and control-oriented and categorically defined regulation. Considered together, there is much inefficiency. These elements do not work well together.

What has been said around the table is that what we really want is markets which can only really be provided by a different kind of regulatory structure, and I now use regulation in a broad sense of the term. What we want is a larger number of third parties with all of the energy and creativity that implies. We want technologies that are part of that market rather than captive or marooned. We want a system that works pretty well, that meshes with the nature of the global markets we are beginning to see. The biggest kinds of changes that are occurring in the global markets are the movement from official sources of capital to market-based sources of capital. There would not really be any problem with Maurice Strong's point, which is emerging nations having access to the technology if, in fact, there were markets for that technology. So the question is not so much do we know the system. I think we all know what the system is that will work. It is what do we do about it. I would be interested in hearing from Jonathan Lash about how we might extend the notion of the experiment, because there are at least five or six of us here who are presiding over various kinds of processes that we could employ to take on a forced march toward his solution if we could start moving toward specifics.

John Gibbons: Jonathan, do you want to pick up on that?

Jonathan Lash: Yes. First, I would observe that this is a matter of intense focus for the President's Council on Sustainable Development. I suspect it will be carefully negotiated by the participants because the concept is easy to describe and much more difficult to execute in a way that all the parties are sure will lead to the result we are describing. Elements of it are outside the regulatory system. The incentive system is not part of the regulations that EPA administers; it has to do with our tax and subsidies system.

The easiest place to start is with the largest industries that are already bringing the most intellectual resources to this process, that have already demonstrated a willingness and an ability to go beyond compliance, and that are looking for the opportunity to step forward and begin to exercise flexibility within their manufacturing process. So long as it is possible to describe quantitatively a set of outcomes in the long term that enable us to verify progress toward those outcomes, the rest of the problems in terms of the necessary changes in the regulatory system, some of which would have to be statutory, can be overcome. The hardest part is defining a set of goals that we can agree upon that are sufficiently quantitative so that we will know if we have achieved them. And the goals should not be so specific in terms of processes that they become in themselves obstacles to the kind of change where you do not set a standard for the by-products of the cleansing process and thereby preclude the elimination of the cleansing process. I think that is all on the table. I would have expected to hear

resistance to that debate, but there is none. It is just whether we have the knowledge to conduct it to a conclusion.

John Gibbons: Maurice Strong, do you agree with that?

Maurice Strong: Yes I do. A related point but on a slightly different aspect of the subject is a need to be as innovative in our financing of the use and dissemination of these technologies as we are in their development. Where a technology relates to a particular product, and people can see quite easily that that product is more economic and desirable for them to buy, that is one thing. But in most cases, in terms of the major infrastructure developments in the developing world, the electric power industry being a major example, the technologies are not discrete in themselves. They are added into much larger investment in facilities. It is the incremental cost that determines whether or not they are going to apply the technology.

I am out on the firing lines very frequently where people say to me that they are prepared to build a gas-fired turbine plant that is going to cost us 30 percent extra. It really is a matter, in practical terms, of being able to finance it. Because energy efficiency, for example, does not isolate itself as a discrete project for financing, usually no effective mechanisms are available for financing energy efficiency. This is the case even though energy efficiency is often the most cost effective investments that can be made. Some of us in the utility business and in the general financing business are, in fact, trying to develop a private financing mechanism that will enable private funding to be mechanized or mobilized for investment in energy efficiency. But right now we do not have the instruments for doing that. We do not have the instruments for separating out the energy efficiency component into a discrete financial package, and then having the financing instrument respond to that need. I think we need to apply as much innovative thinking to financing the use of these technologies as we are now applying to developing them.

Martin Stein: I would like to add to Jonathan's emphasis on the appropriate metrics for success. We have a model with some of the larger companies. But we also have a great mass of people who either do not concur with the need for a model shift or just are uneducated. The best way to educate them would be with appropriate metrics that show it makes good business sense. If we do that, the financing will come because the certainty will drive the financial equation to an attractive one. I think we should focus on that.

Sherri Goodman: To follow up on Bow's question and Jonathan's challenge, I would like to offer the Department of Defense as one of the federal agencies that will be a pilot in this effort to demonstrate a revised approach to how we achieve our environmental goals under a new system. Today, in the defense budget, we spend four to five times as much on environmental compliance, over two billion dollars a year, as we do on pollution prevention, which is in the hundreds of millions. If we could set ten-year goals to performance standards, with strict metrics about how we would measure that and ways to go about it, I suggest we would shift that balance of investment more to prevention and less to compliance. We could probably save money for the nation overall in that ten-year period.

John Gibbons: Good, let's go with it.

Sherri Goodman: We could do this very much with industry. We could pick a sector of the defense industry, e.g., information technology or aircraft. There are many choices. Working with our industry partners, we could be a very effective player in the system.

Let me add to your first point, Jonathan, about how environmental technology can combine economic and environmental benefits. The Defense Department believes that environmental technologies, particularly pollution prevention technologies, can also enhance our military readiness. That is a very important point that needs to be made now. It needs to be made as we go into the new Congress and explain why we make investments in environmental technology, in pollution prevention, etc., in the defense budget.

We have some good examples now of how our modest investments and changes in the way we do business can help. For example, the Navy is now using non-toxic ship coatings which keep the barnacles and zebra mussels off of ships. That not only has environmental benefits because it is not toxic, but it also reduces costs dramatically (by lowering maintenance needs and reducing fuel consumption), and improves readiness (by making the ship more available and able to cruise at higher speeds). In addition, it is dual-use because it is a technology that is also beneficial to the commercial industry, the marine recreational industry. That is just one example, but it is important to make the connection between the economic and environmental benefits and the benefits to military readiness.

Robert Bringer: The ten-year time frame is probably a very good one. On the average, from the passage of command and control legislation until the technology actually has to be installed, it quite often takes ten years or more.

Ismail Serageldin: I wanted to follow up on Maurice Strong's comments. In many of the developing countries there is a huge market for private investment in infrastructure. But it is indeed shackled by the kinds of problems that he was talking about. In America alone, infrastructure needs are going to run about fifty to sixty billion dollars a year for the next decade. That exceeds the available capital and, it is going to require a lot of private sector investment. We and others are looking into ways of inducing the right kinds of technologies and the right kinds of investment by providing guarantees that would enable the higher long-term investments that have a little bit higher up-front cost, but the recouping time would be too far out in the future. We could come in with the governments concerned and provide guarantees. So, it is still a private sector investment, but there are some guarantees that facilitate and remove the risk from the adoption of the right technologies. This is the kind of innovative financing required to reflect the reality that in the last four years private sector flows into the developing world have quadrupled to a hundred and fifty billion dollars a year. The question is, what kind of investments are they going into? Are they going into the kinds of investments that support the propagation of these technologies? What can we do, both as international financial institutions and prominent business and government leaders from the United States and elsewhere, to ensure that a large part of that market goes for environmentally friendly activities and for the promotion of the types of technology that we are looking for?

Diana Natalicio: In thinking about lag time, I am thinking about the lag between what we are doing in our colleges, universities, community colleges and our K-12 educational system and what we are talking about at this conference. I am referring to the exciting ideas and the shift in philosophy that is very clearly on the way. In the short term there has to be a far greater emphasis placed on how we are educating the future professionals, those in whose hands a lot of these issues are going to be placed to carry out the philosophy that we are embracing today. I heard in the education and training sessions an appeal for partnerships, for far greater emphasis on the involvement of the private sector and others interested in future generations of professionals and how they are being prepared. Help is

needed in engineering and business curricula, for example, to get not only the students, but also the faculty, thinking about these ideas.

Going beyond that, consider the role of the community college sector and the clear role that it can play in providing technical expertise. They need the kind of help that is present at this conference and throughout our private sector. Think of the whole issue of teacher preparation. As we talk about all of these exciting ideas, we have to remember that all of us who are here are going to be passing the baton to another generation. We have to ensure that they are prepared to carry the torch when we hand it to them. As we think about these ideas, I hope that we will think about partnerships that extend into the educational sector.

Elizabeth Dowdeswell: I want to pick up on Jonathan's scheme and add one more aspect to the challenge, or, if you like, the encouragement. If we really keep the goal of sustainable development worldwide in mind, it would be really helpful if the sector or the issue that you chose was one of global interest. I throw out the challenge that you extend the benefits immeasurably beyond just the domestic community to the world community by focusing on that sector or those technologies that really bring about responses to the climate change issue.

Barry Naft: It just came to my mind that there is a kind of bridging factor to what Jonathan is saying, in large part due to the fantastic increases in competitiveness that have been spawned by the current administration. We are seeing a rapid growth in the manufacturing of U.S.-based multinationals, and they find themselves in a situation of either taking over or building new facilities in many parts of the world that are not as environmentally developed as the United States. They are faced with some important strategic decisions with regard to what internal level of standards they use for environmental compliance, issues of how to apply technology and which technologies are cost beneficial in doing that. So, there is a very fertile ground right now in terms of the receptivity of U.S. industry in facing up to these issues, being proactive and cooperating in that kind of program.

John Gibbons: Tim, do you have any closing comments on the international context?

Tim Wirth: Thank you, Jack. I will make several points. First, we need to understand these emerging markets that we have been talking about. They are everywhere for us to look at and, in fact, we can organize ourselves in the kind of partnerships that are being discussed here. One example is China and energy, which leads us right to Ismail Serageldin's and Maurice Strong's points about financing. We can accomplish an enormous amount if we can figure out how to close what is a relatively small gap between burning energy in a very dirty fashion and burning in a very clean fashion. If we burn in a clean fashion, it is a tremendous kick for us in the United States economically because that is our technology for the most part. The financing piece for those new markets is crucial.

Another example is coral reefs, which probably nobody around the table has thought much about but they are an enormously important part of biodiversity in the world and of the economies of a lot of very small nations. Without protection by coral reefs, their sand is gone; if the sand is gone, the beach is gone; if the beach is gone, the tourists are gone; and, if the tourists are gone, the economy is dead and we have new floods of refugees coming to the southern shores of the United States. You know the linkage between all of this economically to protect biodiversity, to encourage the tourist industry and to help those countries protect their coral reefs, fits together in a way that is absolutely explainable to the world that we have to deal with on Capitol Hill. The world outside believes we are on a sustainable course. Well, we are not. So, where do we find examples to do it? The financing

part comes into this very, very importantly and we have got to tend to that financing facility. This is enormously important.

Furthermore, we have to be very clear about the need to allow the push of new technologies and challenges to continue. Many of the technologies that have been discussed in the last two days have come out of a commitment to climate change or a commitment to deal with the problems of the ozone layer. Those problems were relatively unknown when they surfaced and we said we have to do something in response. Now they are generating a whole set of new technologies, and we have to continue to do that. Opportunities are going to be out there in biodiversity, population, water, soils and food. There are going to be a whole series of opportunities and we must continue to allow those to bloom.

The partnerships that we talked about are very real. The State Department and USAID, for example, very much need the help of the people in this room who are coming to us and saying, "We've got to change our ways. How can we do a better job of setting up the platforms?" This means the platforms of embassies, USAID offices or financial institutions. We are learning an enormous amount as we go along. From being institutions that were reflections of the Cold War, we are beginning to be reflections of the 21st century. That is extremely important.

The final point is awareness. For the most part, the people in this room are probably sharing a lot of perceptions and understandings about where the world is going. But, I do not believe the perceptions are as broadly shared across the country, and certainly across the world, as we would like them to be. That is the challenge we have in this kind of new partnership for awareness, so that the world out there comes to understand that these are very significant problems we are talking about. We are not talking about a sustainable future if we fail to increase this awareness, increase the capacity to change financing, forge new partnerships, and so on. What you have organized here, Jack, is a great start. We are deeply appreciative of this and are trying to reorganize ourselves to deal with these opportunities. I want to join in with everybody else to thank you for putting this together.

John Gibbons: Thank you. It has been a rich, and certainly an idea-packed, time we have had these past 36 hours. The richness is both in broad scope and vision as well as in detail that we can now not only ingest, but digest and then get back to you. I was thinking about the vision, though, on top of the important detailed ideas. One is a vision of a world in which the future, exemplified by the children performing last night [at the conference dinner], is treated as though it matters. It is a vision of a bright world that, enabled by human ingenuity and by partnerships in technology, can provide options in business and financial innovation, in supportive public policies, and in a society that supports and sustains the kind of commitment that will, in fact, carry us through and leave something that our children can cherish us for.

So, I believe it is been a very, very good time, and we deeply appreciate the kind of energy and investment all of you have made. We hope your investment will be profitable to you and to others as we go along. We do want to maintain the momentum that has been generated by this important gathering. We are developing a strategy document. For those of us that are left behind, your continuing input is going to be critical so we are going to devise ways of continuing the dialogue with you. We will use the GNET that was described in your meeting books, and we look forward to hearing from you about your utilization of that. Our challenge is to translate these many ideas into a strategy document in time for next April and Earth Day.

Incidentally, I neglected to mention a very important contributor to the materials that we have been working with, and that is the Critical Technologies Institute (CTI) of the Rand Corporation. They helped prepare materials, not only for this meeting, but they did a lot of work in the preparation of our original document, *Technology for a Sustainable Future*. I want to thank CTI for that very fine work.

The proceedings of this roundtable and of the entire White House Conference are going to be prepared and mailed to you. We will try to make a fairly quick turnaround because we want the momentum to continue. Also, in the spring, we will hold a few additional workshops to fill in some additional areas. As drafts of the strategy chapters become available, we will put them up on the GNET and solicit your review and feedback. In that way, we can continue to gather collective wisdom and move to the time in which we can elevate not only the level of dialogue, but of consensus in this country. Also, we are so pleased to have the international input here, so generously given. By the time we get to spring our wisdom will, maybe, begin to show. It has been an extremely gratifying time for us here and we appreciate the investment that all of you have made in this joint effort. Let us not consider this conference an end but as an important milestone along the way toward developing a consensus for national and international action. Thank you very much for your time and attention.

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